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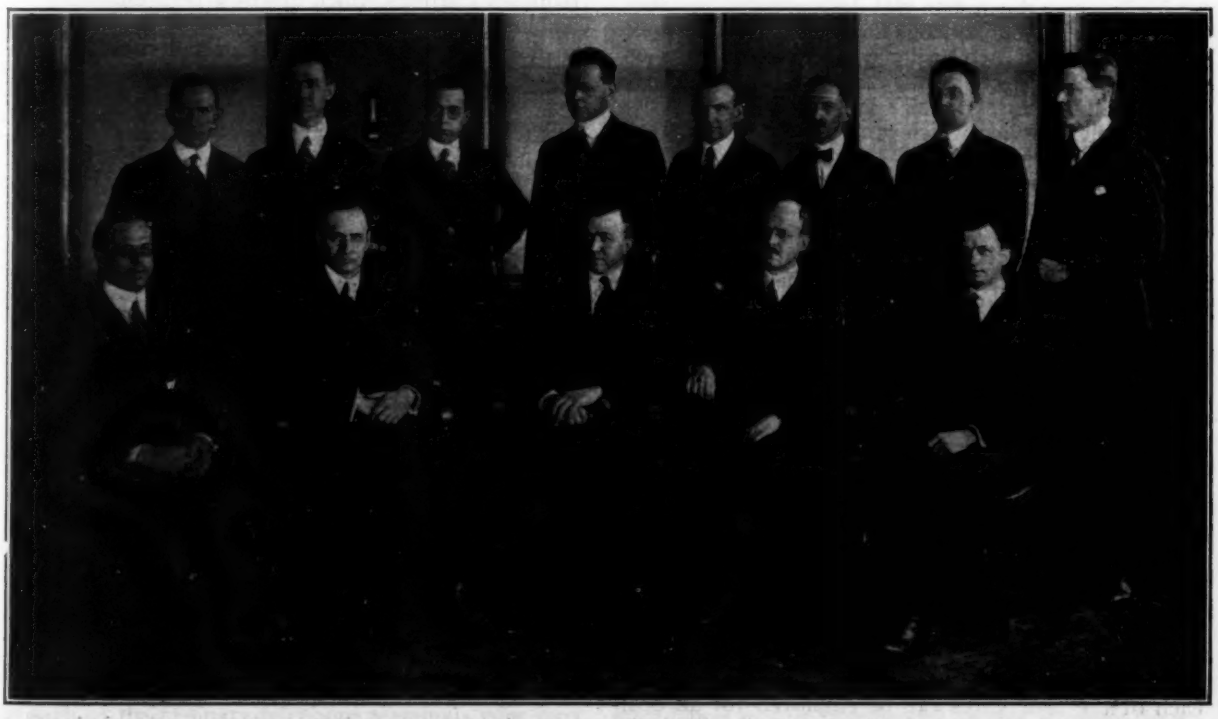
# Modus Operandi of Multiplex Telephony and Telegraphy

## Further Details Concerning the Principles and Application of the Recently Developed System of Multiplex Telephony and Telegraphy—Equipment and Operation of the Washington-Pittsburgh Circuit

EXTRAORDINARY developments in electrical communication were brought about by the intensified application of scientific and engineering research during the war. Two of these were briefly described in recent issues of the ELECTRICAL REVIEW, one being the improvements in radio service resulting from Weagant's invention eliminating the effects of static disturbances, the other being the more recent perfection of multiplex telephony. This latter epoch-making development represents the realization of the dreams of telephone men for some two score years. The announcement of its achievement, as made in the letter of Theodore N. Vail, president of the American Telephone & Telegraph Co., published in our issue of Dec. 21, 1918, came therefore as a very pleasant surprise, many having regarded multiplexing of telephone service as almost chimerical. Along with Mr. Vail's letter, which was addressed to Postmaster-General Burleson as the head of the Government-controlled and consolidated electrical communicating systems of the country, we published a brief explanation of the technical principles of the system as disclosed in an interview with Bancroft Gherardi, acting chief engineer of the American Telephone & Telegraph Co. Through the courtesy of the *Western Electric News* we are enabled to give further particulars and illustra-



**Some of the Men in the Engineering Departments of the Western Electric Co. and the American Telephone & Telegraph Co. Who Have Been Closely Connected With the Development of the Multiplex Telephone.**

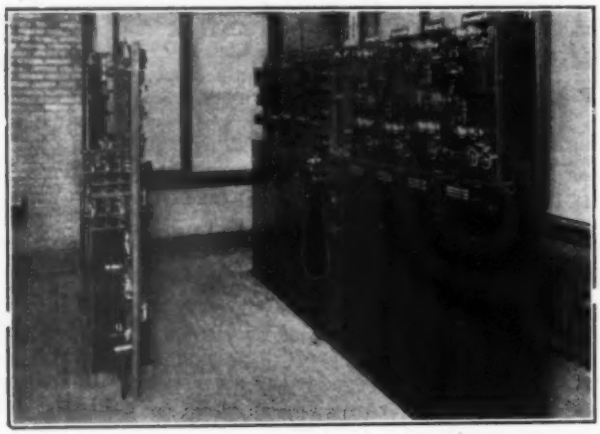
From left to right (standing): H. J. Vennes, W. E. Co.; E. O. Scriven, W. E. Co.; Lloyd Espenschied, A. T. & T. Co.; H. A. Affel, A. T. & T. Co.; H. F. Kortheuer, W. E. Co.; J. R. Carson, A. T. & T. Co.; R. A. Heising, W. E. Co.; John Davidson, Jr., A. T. & T. Co.

(Seated): H. D. Arnold, W. E. Co.; O. B. Blackwell, A. T. & T. Co.; E. H. Colpitts, W. E. Co.; B. W. Kendall, W. E. Co.; H. S. Osborne, A. T. & T. Co.

tions of the new system, these being extracted from an article in the January issue by Frank B. Jewett, chief engineer of the Western Electric Co.

### Application and Practical Limitations of the Multiplex.

The problem of multiplex telephony and telegraphy which the engineering departments of the American Telephone & Telegraph Co. and the Western Electric



**Terminal Apparatus at Tuxedo Test Station, Near Baltimore, Used for Connecting Five Washington Circuits to One Pittsburgh Toll Circuit.**

Co., working in close co-operation, have solved, demonstrated and put into practical commercial operation, is nothing less than the simultaneous use of a single pair of wires for many noninterfering telephone conversations, or many noninterfering telegraph messages, or, if need be, for both. Actually, the commercial service in which the system was demonstrated provides for five pairs of simultaneous noninterfering telephone conversations and two ordinary telegraph circuits on one pair of wires.

As indicated in Mr. Vail's letter, the opportunities for multiplex service which are opened up are great, and for both telephony and telegraphy the practical limits are not now those imposed by physical possibilities, but rather by what it is economical or reasonable to do. For example, it is now *possible* to operate many telephone circuits over a single pair of wires, be they long or short. But since the terminal and intermediate apparatus to provide for the multiplexing involves considerable monetary expenditure, and since an extension of the number of multiplex circuits beyond a certain point would involve much expense in connection with the line, it is neither *economical* nor *practical* to employ the multiplex system on very short line, nor attempt to approach what it is physically possible to obtain in the way of large numbers of circuits.

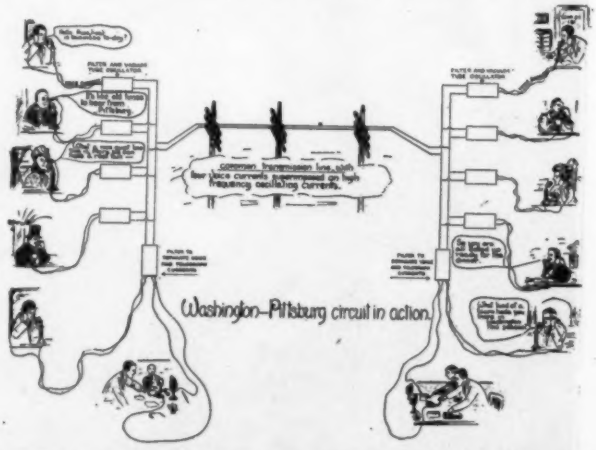
### The Underlying Principles Involved.

To most of us the picture of the modern telephone circuit and what goes over it is reasonably familiar. We know that it has long been possible to take two adjacent metallic telephone circuits and so arrange them as to provide for an additional or phantom circuit. Coincident with this phantom, we know also that each of the four wires can be employed for an ordinary telegraph circuit without interfering with its employment as a part of the telephonic highway. We know, also, that when we talk into a telephone transmitter we generate feeble electric currents which have very curious and complex forms, and which involve a wide range of frequencies—a range which extends up to more than 2000 alternations per second. In a word, we know that, if our telephone transmitter, receiver and line are good, we will have in each part of the circuit a current which pictures a faithful reproduction of the disturbances which the voice produces in the air. We know also that if our circuit is to be satisfactory it must, so far as the receiver at least is concerned, be free from electric currents of voice frequency save only those produced in the transmitter used by the one to whom we are talking.

Since all human voices employ about the same range of frequencies, how is it possible to use a single pair of wires for many simultaneous messages and have each message go only to the terminal apparatus for which it is designed? Why do they not all become mixed up and inextricably tangled when they are waltzing together down the common bypath? It was this difficulty which baffled so many men for so many years, and led to such a great number of ingenious proposals designed to keep separate messages separate. But none of the many schemes that were proposed performed practically until the technical staff of the Bell system began to work with a new principle.

We know that there are ranges of frequencies, both electrical and mechanical, that are beyond the limits of perception by any of our five senses. It has been found that currents of high frequency, for example, obey the same laws as currents of low frequency, and further that these high frequencies have a particular liking for circuits specially dimensioned to receive them, and that each particular high frequency or range of high frequencies, if given a chance to choose between a number of different circuits, will select the one best adapted to its needs, and travel along it in preference to all other circuits. It is this peculiar property of selectivity between different high-frequency currents which has now been employed for combining and separating the various messages that are destined to travel together over a common pathway.

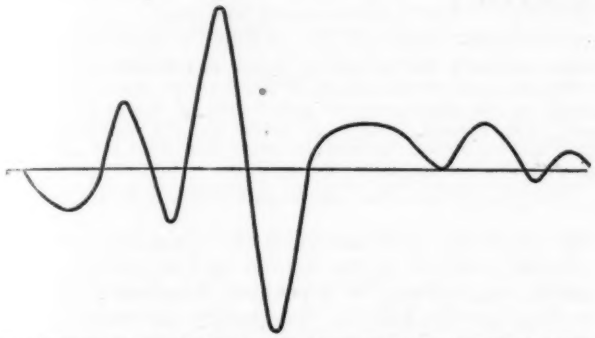
"But there is more to the problem than merely employing a number of different high frequencies and their corresponding circuits," says Mr. Jewett. "We




**Graphic Representation of Five Telephone Conversations and Two Telegraph Messages Transmitted Over One Pair of Wires Between Washington and Pittsburgh.**

must in some way impress upon each of the high-frequency currents the characteristics of the particular voice frequency which we wish to transport to the distant end of the line. Fortunately, one of the devices which we developed in connection with the earlier

work leading up to the transcontinental line and the trans-oceanic wireless telephone furnishes a ready means of so mixing an ordinary voice frequency with a higher frequency that an exact picture of the latter as it emerges from the device would show distinctly the effect which the relatively slow-moving voice current had had in lopping off the tops of the high-frequency waves. This same ingenious device, which we all know is the vacuum-tube amplifier, can serve

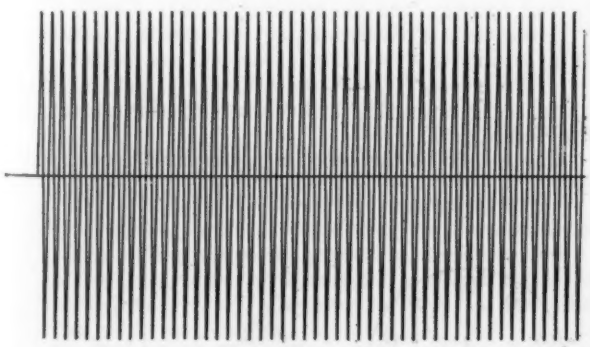


Oscillogram of a Typical Voice Current as Transmitted Over an Ordinary Telephone Circuit.

equally to divorce completely a union of high and low frequencies which may be handed to it. All this, of course, is properly associated with numerous other pieces of apparatus, the most notable of which are the filtering circuits, without which the vacuum tube would be impotent.

### Commercial Application of the System.

"Here, then, is the basis for the commercial plant referred to in Mr. Vail's letter, and now giving service between Washington and Pittsburgh. Actually, the multiplex section of the line extends from the Tuxedo test station, just outside the city of Baltimore, to the Brushton test station, just outside the city of Pittsburg. From Washington to Tuxedo, and from Pittsburgh to Brushton, there are provided as many ordinary telephone circuits as are required for the ordinary and multiplex use of the toll line between Tuxedo and Brushton—in this particular case five. None of these five circuits is in any way different from an ordinary telephone circuit, either from the standpoint of talking, signaling or operating. At Tuxedo and at Brush-



Oscillogram of an Unmodified High-Frequency Current.

ton each of the ordinary telephone terminals runs into its own particular piece of apparatus. One of the terminals, namely, that one which is to use the toll line in the ordinary way, goes directly to the latter through an equipment which prevents any of the outgoing or incoming high-frequency currents from going back to the terminal. Each of the other terminals goes through an apparatus which, for outgoing transmission, combines the voice currents with a particular higher frequency current or carrier. This latter, when modulated by the voice currents, passes out to the toll line through an apparatus especially adapted to that particular carrier when loaded with its heterogeneous mass of voice frequencies, and to no other carrier. At the distant end of the line the first, or ordinary, conversation passes through its proper selecting apparatus directly onto the terminal designed for ordinary working, and each of the four other carriers pops into its own designated circuit, where, after being divested of its patent carrier, the demodulated voice frequency goes out on an ordinary telephone line to the distant subscriber.

"In the meantime, telegraph currents have been flying back and forth over the wires of the circuit without interference to or from the various voice and carrier currents that have been in play.

"Thus it happens that at any given instant the two wires of the toll line have impressed upon them a heterogeneous mass of high-frequency carriers, human voice currents, telegraph currents and such control currents as it may be necessary to employ for the proper operation of the terminal apparatus. An electrical picture of what is taking place in the toll line itself would be unintelligible to any of our senses."

### How the Development Was Brought About.

Mr. Jewett's article concludes with a few words on the history of the development. He says: "Even

Oscillogram of a High-Frequency Current Modified to Transmit the Characteristics of a Voice Current.

before the transcontinental telephone line from New York to San Francisco had been installed it was realized by the Western Electric engineers and those of the American Telephone & Telegraph Co. that the work which had been done in connection with that problem would be of great assistance in solving the problem of multiplex transmission over wires, and more than four years ago apparatus was set up in the research laboratories of the Western Electric Co. with which it was possible to carry on more than one conversation over a pair of wires. Following this the work was pushed, and in the latter part of 1916 and early in 1917 a trial installation was made and put into service on a part of the line between New York and Chicago. From the experiments on this line grew the installation now in commercial service between Washington and Pittsburgh, and, in view of the telephone conditions which existed in Washington at the peak of the war load, it was fortunate indeed that we began polishing up Aladdin's lamp when we did."

# Power and Torque in Electric Motors

## Second of a Series of Articles Discussing the Basic Principles of Different Types of Motors From a Common Standpoint — Direct-Current and Polyphase Induction Motors

By JUSTIN LEBOVICI

*Lack of clear understanding of the action of alternating-current motors is due largely to failure to consider their principles on a common basis applicable to all classes of motors. In this series of articles Mr. Lebovici presents a discussion of power and torque of different kinds of motors based on the principles of the direct-current motor and of the static transformer. The fundamentals were reviewed in the first installment. The present installment takes up the direct-current motor and begins discussion of the polyphase induction type. These articles should be read in connection with the author's two series of articles on alternating-current motors and windings published in our issues during 1916.*

THE first article of this series discussed the production of electromotive forces and currents in motors due to transformer action and to rotation, also the production of torque and armature current. We are now ready to apply these general fundamental principles to the different types of motors.

### Direct-Current Motors.

Fig. 17 shows diagrammatically a separately excited direct-current motor. Let $V_1$ and $V_3$ be the potential difference of the terminals to which the starter (or field winding) and rotor (or armature) are respectively connected.

Since we are dealing with direct currents, we consider the reactance $x_1$ and $x_3$ of the windings $W_1$ and $W_2$ (see Fig. 17) zero. A current $i_1$ limited only by the winding resistance $r_1$ will flow in the stator winding $W_1$, magnetizing in space along the $YY$ axis in the assumed top-bottom direction. We plot $V_1$, $\phi_1$ and $i_1$ in the time diagram Fig. 18 from right to left as shown. At the moment of starting the motor (Fig. 17), the current $i_3$ in winding $W_2$, having $W_2$ turns in series, is only limited by the rotor resistance $r_2$ (assuming no external resistance) and the direction of $i_3$ depends upon the connection to the line. In Fig. 17 we assumed $i_3$ to magnetize in a negative direction. Due to interaction between $i_3 W_2$ and flux $\phi_1$ rotation will result in a counter-clockwise direction; due to rotation of $W_2$ in $\phi_1$ the counter emf. $E_{3r}$ will be generated, magnetizing in a positive direction as shown in Fig. 19. We plot $E_{3r}$ in a positive direction and in phase with $\phi_1$ (in line with the rule given) and $V_3$ and $i_3$ in opposition to $E_{3r}$ as shown in Fig. 20.

The flux $\phi_1$ and the current $i_3$, being in time phase (see Fig. 20) and space quadrature (see Fig. 17), are in a very favorable relation to produce torque. The torque acting at the armature periphery can be calculated by means of equation (11) by noting that when dealing with direct current $\phi=\phi_1$ and cos $(E_{3r}, I)=1$. We can then write for the torque $T$

$$T=0.235\, p\, W_2\, \phi_1\, i_3 \quad \ldots\ldots\ldots\ldots\ldots\ldots (12)$$

The value of the counter emf. $E_{3r}$ can be calculated from equation (10), thus

$$E_{3r}=4\times pn/120\times W_2\times\phi_1\times 10^{-2} \quad \ldots\ldots\ldots (13)$$

The emf. acting on the winding $W_2$ at the speed $n$ is the difference between $V_3$ and $E_{3r}$ as shown in Fig. 21 and the current flowing through the $W_2$ turns in series having resistance $r_2$ is

$$i_3=(V_3-E_{3r})/r_2 \text{ or } i_3 r_2=V_3-E_{3r} \quad \ldots\ldots (14)$$

The power input $P_1$ to the rotor measured in watts is given thus

$$P_1=V_3 i_3 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (15)$$

The power output $P$ of the armature measured in watts is given by equation (5) thus

$$P=E_{3r} i_3 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (16)$$

since it is seen from Fig. 20 that cost $(E_3, i_3)=1$.

$P_1$ includes the iron losses, the bearing and brush friction, windage and the winding losses.

Subtracting (16) from (15) we obtain, by substituting from (14),

$$P_1-P=i_3\,(V_3-E_{3r})=i_3^2 r_2 \quad \ldots\ldots\ldots\ldots (17)$$

or $i_3^2 r_2$ is the power lost as heat developed in the armature winding.

The torque at the speed $n$ is obtained from equa-

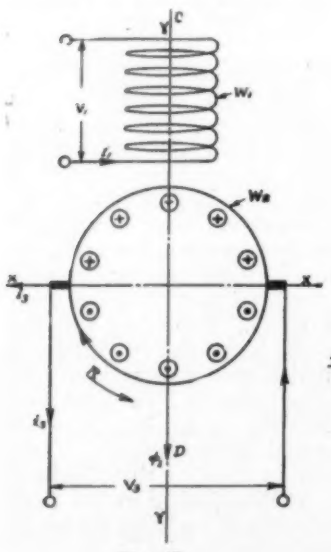



Fig. 17.

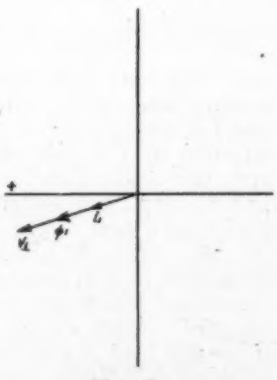



Fig. 18.

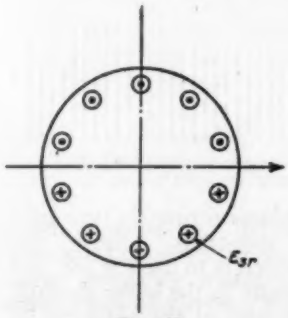



Fig. 19.

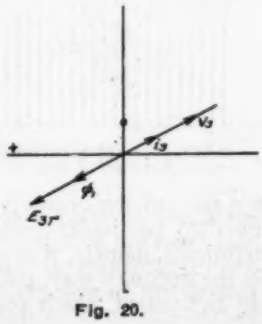



Fig. 20.

tion (9), remembering that cos $(E_r, I)$ is here equal to 1; thus

$$T = 7.05\, E_{3r}\, i_3/n \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (18)$$

The speed and torque characteristics of the shunt, series, cumulative compound and differential compound motors can be easily obtained by the application of the principles and formulas just given.

## Polyphase Induction Motor.

*(a) Production of Torque.*

Fig. 22 shows diagrammatically a two-phase motor of the squirrel-cage or phase-wound type. The two stator windings $S_1$ and $S_4$, of $W_1$ turns respectively, are displaced in space by 90° and connected to two identical emf's $V_1$ and $V_4$ displaced in time by 90°. The emf's $V_1$ and $V_4$ give rise to fluxes $\phi_1$ and $\phi_4$ (as shown in Fig. 26) lagging 90° behind the emf. producing same.

The rotor is assumed to have the same time constant in all directions.

Considering the transformer axis $YY$ (at the instant shown in Fig. 26) we notice that the emf. $V_1$ impressed on $S_1$ (Fig. 24) will determine the magnetizing current $I_{m1}$ lagging far behind $V_1$ (see Fig. 23)

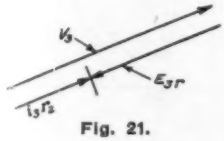



Fig. 21.

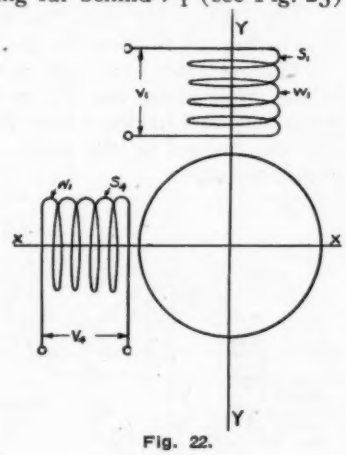



Fig. 22.

and produce the flux of mutual induction $\phi_1$ magnetizing, according to assumption, from top to bottom in the space diagram Fig. 24.

The flux through its pulsations in the axis $YY$ induces emf's in the winding $S_1$ and in the rotor winding along $YY$. These emf's are, according to Lenz's law, so directed that any currents resulting from same would oppose the change in flux. Hence an emf. $E_{3p}$ will be induced by pulsation along the axis $YY$ lagging in time 90° behind $\phi_1$. The magnitude and time-phase position of the current $I_3$ is determined, as long as the rotor is at standstill, by the rotor constants: the inductive and the ohmic resistance of the rotor windings. This is shown in Fig. 23.

Considering the $XX$ axis (at the instant shown in Fig. 26) we have similarly the impressed emf. $V_4$ determining $I_{m4}$ and $\phi_4$; according to convention, $\phi_4$ is drawn in the space diagram Fig. 25 from left to right. Flux $\phi_4$ induces the emf. $E_{2p}$ which gives rise to the rotor current $I_2$ lagging behind $E_{2p}$ the same amount as $I_3$ was lagging behind $E_{3p}$.

Since the emf. $E_{3p}$ will produce currents $I_3$ lining up along the $YY$ axis, these currents can only produce torque with the flux $\phi_4$ not in the same axis. Hence, we have a torque due to $I_3$ and $\phi_4$ (Fig. 25). Similarly we will have a torque due to $I_2$ and $\phi_1$ (Fig. 24).

The direction of rotation of the rotor can be determined by means of Fleming's left-hand rule from

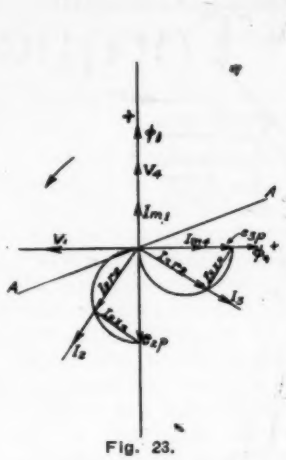



Fig. 23.

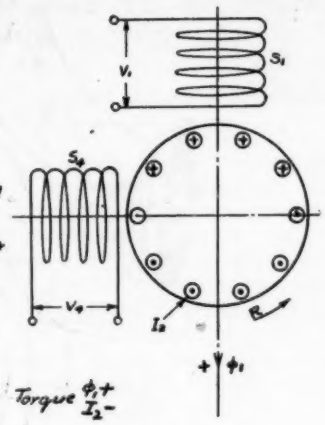



Fig. 24.

Figs. 24 and 25, as shown in Figs. 27 and 28, and is in the case assumed in Fig. 26 counter-clockwise.

The direction of rotor rotation can also be obtained from the time diagram, Fig. 23, without using Fig. 26, as follows:

To determine the direction in which the rotor would move under the influence of these torques, we can draw arbitrarily a line $AA$, as in Fig. 23, and refer all the vectors to this axis.

Projecting $I_3$ and $\phi_4$ on $AA$ we note that $I_3$ and $\phi_4$ projections are both positive. Hence we draw in Fig. 25 $\phi_4$ in a positive direction and $I_3$ so as to magnetize in space in a positive direction.

Projecting $I_2$ and $\phi_1$ on $AA$ we note that the projection of $I_2$ is negative, while the projection of $\phi_1$ on $AA$ is positive. We draw in Fig. 24 $\phi_1$ in a positive direction and $I_2$ magnetizing in a negative axis. The resultant direction of rotation can be determined from Figs. 24 and 25 and for the case under consideration we note that the rotor would move in a counter-clockwise direction.

*(b) Normal Running Conditions.*

In considering the normal operation of the polyphase induction motor after the rotor has reached full-load speed it is at once apparent that the fluxes $\phi_1$ and $\phi_4$ will continue to induce by their pulsation the emf. $E_{3p}$ along the $YY$ axis and the emf. $E_{2p}$ along the $XX$ axis, respectively. We can then plot $\phi_1$, $\phi_4$, $E_{3p}$ and $E_{2p}$ in the time diagram, as shown in Fig. 29 for the $YY$ axis and in Fig. 32 for the $XX$ axis.

Due to the rotation of the rotor conductors in the

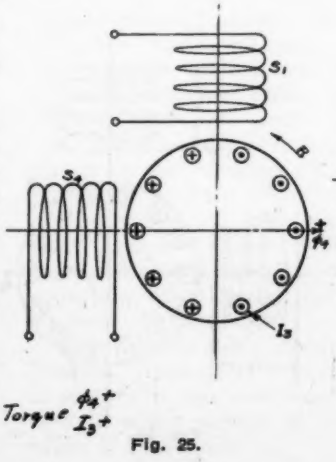



Fig. 25.

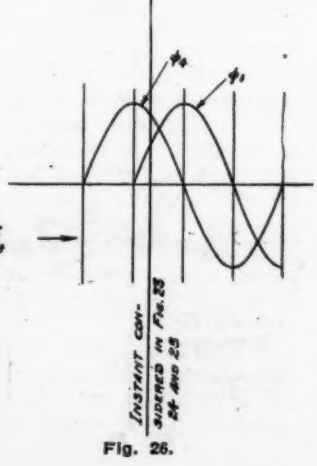



Fig. 26.

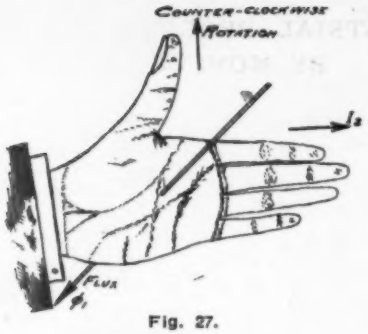



Fig. 27.

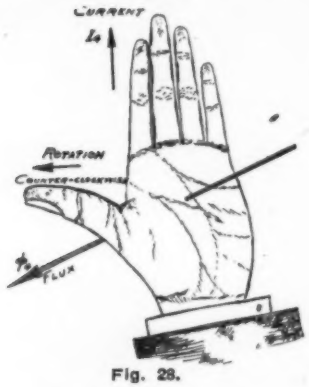



Fig. 28.

flux $\phi_4$ emf's will be generated in these conductors lining up along the $YY$ axis and combining with the emf's of pulsation along the same axis. Assuming all the conductors in series, we would obtain along $YY$ our emf. $E_{3r}$ magnetizing along a negative axis as shown in Fig. 30. We will plot $E_{3r}$ in the time diagram, Fig. 29, along the line of the flux $\phi_4$ and in a negative direction in line with what has been previously said.

Calling $f_r$ the frequency of rotation, or $f_r$=poles× r.p.m./120, we can calculate the effective value of $E_{3r}$ from the equation:

$$E_{3r}=2\sqrt{2}f_r W_2\phi_4 10^{-2} \text{ volts} \quad \ldots\ldots\ldots\ldots (19)$$

but the emf. due to the pulsation of the flux is obtained from

$$E_{3p}=2\sqrt{2}fW_2\phi_1 10^{-2} \text{ volts} \quad \ldots\ldots\ldots\ldots (20)$$

where $f$ is the frequency of supply. Noting that $\phi_1=\phi_4=\phi$ we can write

$$E_{3r}=2\sqrt{2}f_r W_2\phi_4 10^{-2}=(f_r/f)2\sqrt{2}fW_2\phi_1 10^{-2}$$
$$=(f_r/f)E_{3p} \quad \ldots\ldots\ldots\ldots (21)$$

Barring leakage, the emf. acting on the rotor along the axis $YY$ will be the geometrical sum of $E_{3p}$ and $E_{3r}$ and hence according to Fig. 29 the current $I_3$ is given by the formula

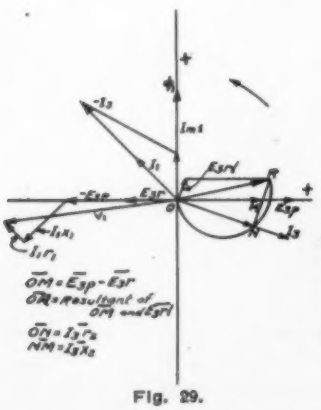



Fig. 29.

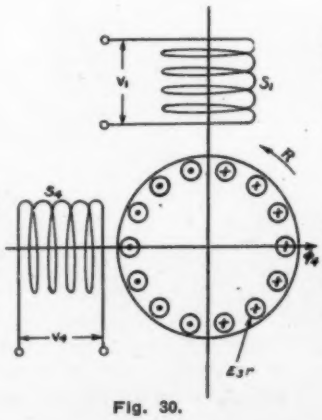



Fig. 30.

$$I_3=\frac{E_{3p}-E_{3r}}{\sqrt{r_3^2+x_3^2}}=\frac{E_{3p}(1-f_r/f)}{\sqrt{r_3^2+x_3^2}} \quad \ldots\ldots\ldots\ldots (22)$$

Similar conditions prevail along the axis $XX$. Due to the rotation of the rotor conductors in the flux $\phi_1$, an emf. $E_{2r}$ is generated, magnetizing along $XX$ in a positive direction as shown in Fig. 33. $E_{2r}$ will be plotted in the time diagram, Fig. 32, along the same line as the flux $\phi$ and in a positive direction. Barring leakage, the resultant emf. acting on the rotor winding along $XX$ is $E_{2p}$—$E_{2r}$ which would give rise to a current

$$I_2=\frac{E_{2p}-E_{2r}}{\sqrt{r_2^2+x_2^2}}=\frac{E_{2p}(1-f_r/f)}{\sqrt{r_2^2+x_2^2}} \quad \ldots\ldots\ldots\ldots (23)$$

The current $I_2$ produces along the $XX$ axis a leakage flux $\phi_{41}$. The flux $\phi_{41}$ induces by pulsations an emf. called the reactance voltage $I_2x_2$. It will be noticed, however, that the rotor conductors cut, due to their rotation, not only the flux $\phi_4$ but also the flux $\phi_{41}$. The emf. $E_{3r1}$ generated by rotation in the flux $\phi_{41}$ (see Fig. 31) magnetizes along a positive axis and will be plotted in Fig. 29 along the line of the current $I_2$ and having a component along the positive axis as shown in Fig. 29.

The emf. $\overline{OM}=E_{3p}$—$E_{3r}$ combines with the emf. $E_{3r1}$ in Fig. 29 to form the resultant emf. $\overline{OR}$.

The resultant emf. $\overline{OR}$ will produce a current $I_3$ in the rotor along the $YY$ axis limited by the rotor impedance and having a time-phase displacement from $\overline{OR}$ determined by the ratio of the inductive to the ohmic resistance.

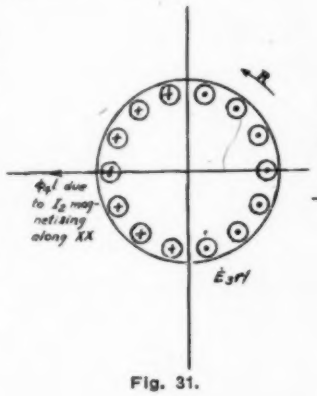



Fig. 31.

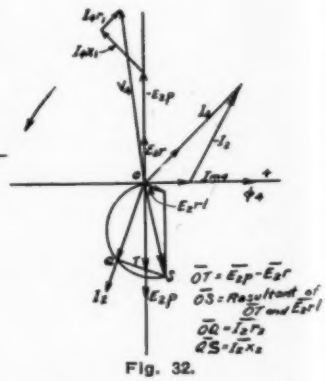



Fig. 32.

We note that $E_{3r1}$ will bear the same relation to the emf. $I_3x_2$ due to the leakage flux as $E_{3r}$ bears to $E_{3p}$ or, according to (21),

$$E_{3r}=(f_r/f)E_{3p} \quad \ldots\ldots\ldots\ldots (21)$$

Hence

$$E_{3r1}=(f_r/f)I_3x_2 \quad \ldots\ldots\ldots\ldots (24)$$

and, since according to Fig. 29, $E_{3r1}$ *and* $I_3x_2$ are parallel and opposing each other, it follows that only their difference will be active in the motor circuit, or the rotor reactance $x_{3\cdot2}$ along the $YY$ axis becomes:

$$x_{3\cdot2}=x_3=[x_2-(f_r/f)x_2]=x_2[1-f_r/f] \quad \ldots (25)$$

The quantity

$$1-f_r/f=(f-f_r)/f=s \quad \ldots\ldots\ldots\ldots (26)$$

giving the difference between the frequency of the supply and the frequency of rotation in percentage of the frequency of supply is given the name *slip*. The rotor current $I_3$ in formulas (22) and (23) should then be corrected as follows:

$$I_3=\frac{s\,E_{3p}}{\sqrt{r_3^2+s^2x_3^2}}=\frac{E_{3p}}{\sqrt{\left(\frac{r_3}{s}\right)^2+x_3^2}} \quad \ldots\ldots\ldots\ldots (27)$$

It is seen then that due to the emf. generated through rotation in the leakage flux $\phi_{s1}$ produced by the rotor current $I_3$ the inductive drop of the current $I_3$ is reduced and the phase displacement between the voltage impressed on the rotor and the current $I_3$ is also reduced.

The rotor current $I_3$ produces a leakage flux $\phi_{r1}$ combining along the vertical axis (see Fig. 34). $I_3$ magnetizes in opposition to $\phi_1$ in Fig. 29 and is drawn accordingly in Fig. 32. The emf. generated by rotation in the flux $\phi_{r1}$ magnetizes along a negative axis. $E_{2r1}$ is plotted in Fig. 32 in line with the current $I_3$ and having a component along the negative $\phi_1$ axis, that is, Y axis.

$E_{2r1}$ combines with $\overline{OT}=E_{2p}-E_{2r}$ to a resultant $\overline{OS}$ as shown in Fig. 32. $\overline{OS}$ determines the current $I_2$ and we obtain, same as above,

$$I_2=\frac{s\,E_{2p}}{\sqrt{r_2^2+s^2x_2^2}}=\frac{E_{2p}}{\sqrt{\left(\frac{r_2}{s}\right)^2+x_2^2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (28)$$

Since $I_2=I_3$ and $E_{2p}=E_{3p}$, the relation (28) holds good for the axis of any stator phase.

For a ratio of transformation 1:1 the stator current $I_1$ in the winding $S_1$ will be the geometrical sum

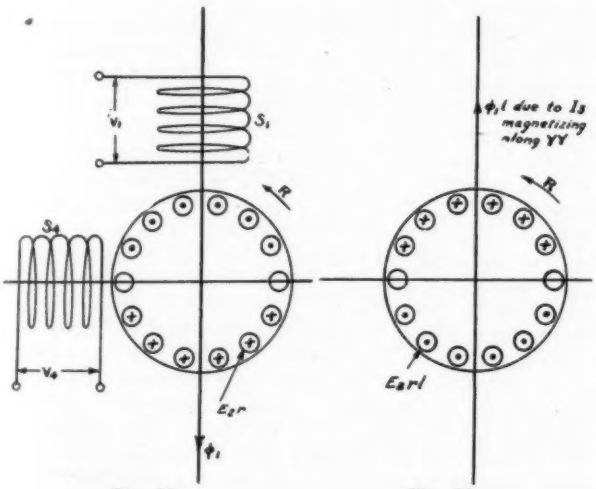



Fig. 33.




Fig. 34.

of $I_{m1}$ and $-I_3$ and similarly the current $I_4$ in the stator winding $S_4$ will be the vector sum of $I_{m4}$ and $-I_2$, as shown in Figs. 29 and 32, respectively.

The applied line voltage $V_1$ will be the vector sum of $-E_{2p}$, the reluctance drop $I_1X_1$ at right angle to $I_1$, and $I_1r_1$ in line with $I_1$, as shown in Fig. 29. The line voltage $V_4$ is the vector sum of $-E_{2p}$, $I_4X_1$ *and* $I_4r_2$, as shown in Fig. 32. The voltage $V_4$ is equal to $V_1$ and lags 90° behind $V_1$, as it should, according to assumptions made at the beginning of this section, this being a two-phase motor.

It can be seen from Figs. 29 and 32 that as long as the machine runs as a motor, $E_r$ must be smaller than $E_p$ and $E_{r1}$ smaller than $I_2x_2$, hence the current $I_2$ must always lag behind $E_p$. In consequence $I_1$ will always lag behind $V_1$ in the short-circuited rotor type of induction motor and the power-factor can never be unity.

By increasing $E_{r1}$ through providing either a commutator or a phase-advancer it can be easily seen how the power-factor of the motor can be made unity or leading.

*(To be continued.)*

## INDUSTRIAL PROGRESS TO BE SHOWN BY MOVING PICTURES.

**Unique Plan Adopted by Louisville Industrial Foundation in Report to Stockholders.**

It is announced by Tampton Aubuchon, general manager of the Louisville Industrial Foundation, that the organization's annual report to the stockholders will be partly rendered in motion pictures. About twenty new industries have been located in the city of Louisville as the result of the Foundation's activities, and camera men are busily engaged in photographing the salient features of the various new factories in order that an intimate review of the industries, their processes and products, may be presented to the stockholders and the citizens of Louisville. It is the idea of the Foundation directors that the stockholders and citizens should be afforded an opportunity to visit all of the new plants located in the city and the motion-picture method was adopted as the most practicable. The contract was made for the work with the Rothacker Film Manufacturing Co., Chicago, who will produce the films. This company specializes on commercial and industrial films.

The idea of presenting an annual report in moving pictures is unique and it is believed to be original in its application in Louisville. The motion-picture manufacturers of the country are keenly interested in the success of the idea, for it is hoped that through Louisville's experiment the cinematograph will ultimately be utilized as an assistive force in the development of communities and in the solution of civic and industrial problems. The use of the film in merchandising is quite popular now but its adoption as a means of presenting a clear and impressive record of the accomplishments of an industrial development organization is said to be without precedent.

One of the prominent features of the film will be to show that, although a large number of industries were located in Louisville during the period of the war, none of them are strictly war industries but, as the pictures will reveal, are engaged in the manufacture of peace products, a development along permanent, substantial lines.

## NEW ELECTRICAL INSTALLATIONS MADE AT TACOMA LUMBER MILLS.

The new electrical installations recently completed by the Wheeler-Osgood Lumber Co., at Tacoma, Wash., have added materially to its production and consumption of power. Besides the Rateau-Ridgway 1250-kva. turbogenerator, installed at its sawmill power house, there has been put in at the same place a General Electric 150-hp. motor for operating planing-mill machines; and a 3-panel switchboard. Excess power produced is transmitted at 2200 volts, 3 phase, to the company's door factory and veneering plant on the Tide Flats, where a General Electric 100-hp. motor was installed for operating a veneering lathe. The new power received here is controlled from a 3-panel switchboard, recently installed. E. J. Barry, consulting electrical engineer, Tacoma, had charge of all these installations.

The Tide-Water Lumber Co., whose new mill near Tacoma, Wash., was completed recently, uses 812 hp. in motors at 440 volts, and buys its power from the electric power system of the Puget Sound Traction, Light & Power Co.

# Checking Calibration of Thermocouples and Pyrometers

## Sources of Error in Thermocouples, Pyrometers and Leads — Methods of Testing Works Units Against Secondary and Works Standards — Maintenance of Standards—Apparatus Recommended for Carrying on Work

SUCCESSFUL use of pyrometers requires some means of checking. The pyrometer is a precision gauge subjected to extremely severe conditions no matter how much care may be given it. To be of practical value it must command respect for its accuracy. In the minds of the men who use it, it is in competition with a measuring instrument which, within its own limits, is quite reliable and upon which many men place great reliance, namely, the human eye. The pyrometer, left to itself, may very easily become less accurate than the human eye and if it does, confidence will be lost in it.

This condition must be guarded against carefully if standards of product are to be maintained. Present-day requirements as to quality require an accuracy and constancy in temperature control considerably beyond that possible with the human eye, and uniform results are possible only through the use of an accurate pyrometer. All pyrometers should be checked at such frequent intervals, therefore, that there is no chance whatever that the workman will ever find the instruments wrong. This procedure has become the standard practice of many of the large manufacturing concerns during the past few years and it is a practice which is rapidly spreading.

Different pyrometer systems require different amounts of attention, but all may be handled by a standard checking method, and the most practicable method is that employed for checking many other instruments, namely, by comparison with a standard. The pyrometer may be considered as consisting of at least two, if not three, parts independently liable to error; and when an inaccuracy is discovered it must be traced to its source in the thermocouple, in the measuring instrument, or in the lead wires connecting the two. A method that has been found efficient and reliable for carrying out the necessary tests, and suggestions for various equipments suitable for the work follows.

The method, in brief, provides (1) for the maintenance of standards of temperatures in the plant, and (2) for convenient comparison of these standards with the works instruments. The standard of temperature for the works should consist of at least one platinum-platinum-10%-rhodium thermocouple previously calibrated by the Bureau of Standards and a potentiometer. While one platinum couple does suffice, it is most desirable that three platinum couples be available for comparison, one against the other. The couple must, of course, be subjected to high temperature when used and it is not impossible that it may change. If one couple only is available, such change will not be manifest to the operator until the damage due to faulty temperature determinations has been done. If two couples are available and one changes, there is no way of telling which has changed. With three couples available if one changes it will be immediately apparent which one it is that has changed.

The platinum thermocouple used regularly for checking of the thermocouples should be mounted in a protecting tube with a mercurial thermometer in the head; the other two being unmounted and when not in use can be kept in a safe. The mounted platinum thermocouple is used for calibrating secondary standard couples, which can be of the base metal type, and these standard base metal couples can be carried about in the works for checking thermocouples in working furnaces. Checking working standards against the fundamental standard should be made frequently enough to insure against faulty calibration. The stock of secondary standard base-metal couples which have been checked in the laboratory against the platinum couple also serves as a reserve for replacing works couples which are burned out. A number of the secondary standards can be checked up at once against the platinum couple. The standard couple or couples should be used for standardizing purposes only, and with a potentiometer, since the potentiometer is the recognized and universally accepted standard instrument for electromotive force measurements.

For use with the thermocouples and potentiometers there should be a large electric furnace having a zone of uniform temperature extending at least 12 in. throughout which temperature variation is not in excess of 20° F. This furnace should have an internal cross section of not less than the equivalent of a circle 2 to 2½ in. in diameter. All thermocouples should be checked in the laboratory furnace. The couple on test is placed in the furnace with its hot junction in as close contact as possible with the hot junction of the standard platinum couple long enough for conditions to stabilize. Readings are then taken alternately on the platinum standard and on the works instrument. With the relation of electromotive force to temperature for the base metal couples ascertained, the latter may be put into service immediately or used as secondary standards for calibrating couples already in use.

The base-metal couples, thus standardized, may be used as secondary standards and are inserted into the works furnaces so that the hot junction of the secondary standard couple is in as close proximity as possible to the couple to be checked. After the secondary standard in the furnace has come to temperature, it is read by means of the portable potentiometer and the readings contrasted with those of the works instrument. If in agreement and the works instrument is in good condition, the operator may pass to the next instrument to be checked. If there is a discrepancy of sufficient magnitude to justify attention, the source of error must be found.

### Sources of Error in Thermocouple Pyrometers and Remedies.

What actually is measured is the e.m.f. generated by the thermocouple and what is to be determined is

the relation of this e.m.f. to the difference in temperature between the hot end and the cold end of the couple. Any deviation of the e.m.f. actually generated for a given temperature from the predetermined or assumed value will lead to an error in inferring the temperature. To ascertain whether such change has taken place, the service couple should be connected directly to the portable checking instrument and readings alternately taken on the secondary standard couple and the service couple, thus ascertaining the condition of the service couple itself, apart from all other factors.

Errors due variations in the e.m.f. generated by the hot junction at given temperatures can be rendered less frequent by protecting the thermocouples as much as possible against contamination, using always the same depth of immersion, and by discarding old

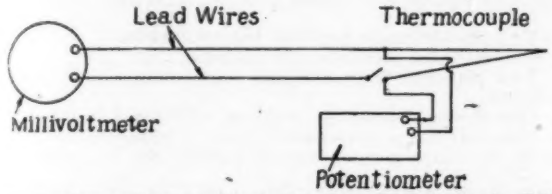



Fig. 1.—Connection for Measuring True Thermocouple E.M.F.

couples systematically. Furnace gases and vapors often diffuse at high temperatures through protecting sheaths and affect the couple characteristics. The best guarantee of accuracy, however, is careful checking or calibration initially and frequent recalibration. Where the safety and quality of work depend upon accuracy, it is therefore essential that checking of thermocouples be made part of the regular routine.

As the voltage generated by the thermocouple depends upon the difference between the hot end and the cold end of the thermocouple, the temperature of the cold end must be known in order to arrive at the temperature of the hot end. The cold end of the thermocouple is that point at which the special alloys which constitute the thermocouple terminate and are connected either to the copper leads which are in turn connected with the measuring instrument, or where the special alloys themselves terminate at the measuring instrument.

If the e.m.f. generated by the couple is measured by measuring the current which it can produce, errors may appear, due changes in thermocouple resistance, of the lead wires or of the millivoltmeter, or to changes in the calibration of the galvanometer, traceable to changes in the pivot or suspension of the coil or to variations in the magnetic field, or thirdly, they

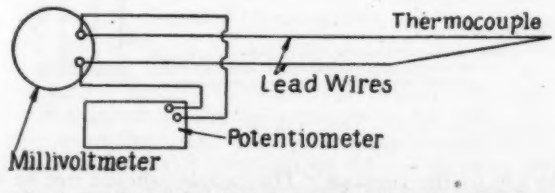



Fig. 2.—Connection for Measuring True Thermocouple E.M.F. Less Drop in Couple and Leads.

may be due to the fact that the thermocouple cold end temperature is different from that for which the millivoltmeter was calibrated.

The loss of potential due the flow of current through the lead wires for which each millivoltmeter in service is intended should be known. To determine the effect of resistance on the reading, first connect a potentiometer to the terminals of the thermocouple, disconnecting the millivoltmeter, as in Fig. 1, and take a reading. Then connect the couple to its millivoltmeter and connect potentiometer also to the terminals of the millivoltmeter, as in Fig. 2, and take a second reading. The difference between the two readings gives the voltage drop due current flowing through thermocouple and lead wires. Any variations in this difference which may occur on successive calibrations will appear directly as errors in the pyrometer.

To still further determine the source of such variations, a third test (Fig. 3) may be made by connecting directly to the terminals of the thermocouple, with the couple connected to its millivoltmeter, and contrasting the resultant measurement with the e.m.f. of the couple connected to the potentiometer only. The difference between these two readings shows the couple drop only and as the couple deteriorates the difference between the value as connected in Fig. 1 and the reading as in Fig. 3 will show the effect of increase in the resistance of the couple itself, due to temperature or other causes. The lower the resistance of the millivoltmeter, the more frequently should this test be applied, for the greater will be the relative influence of the thermocouple resistance.

If after the above tests, no resistance trouble is located in the leads or in the thermocouple, and the couple itself gives the proper voltage, and the pyrometer still reads in error, the trouble must be in the millivoltmeter.

*Cold Junction Temperature Effect With Millivoltmeter.*—A thermal e.m.f. is generated at the cold junction of the two metals forming the thermocouples, as well as at the hot junction, and the net e.m.f. actually measured is the difference between the two. The e.m.f. of the cold junction is small and ordinarily not subject to important variations, since the cold end is not ordinarily subjected to high temperatures, con-

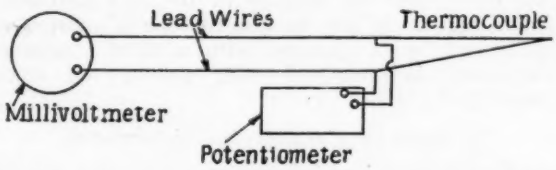



Fig. 3.—Connection for Measuring True Thermocouple E.M.F. Less Drop in Couple.

taminating gases or other conditions which would be apt to modify its characteristics. The necessity of making any correction for the cold end may be eliminated by holding the temperature of the cold end always at the temperature for which the pyrometer was calibrated, as by surrounding the cold end with a jacket through which water is circulated, or by enclosing it within a steam box or an ice box. Another method is to bury the cold end in the earth, not less than 10 ft. and not near sources of high temperature. It is wise to take the temperature of the cold end periodically by a mercury thermometer, as unsuspected variations may occur, due to the clogging of water, steam circulation or changes in sub-surface temperatures brought about by building operations, heating systems, etc. Any variations in cold end temperature thus discovered must be allowed for, as explained later.

Where provision is made for keeping the cold end temperature constant, extension leads of the same materials as the thermocouple itself must be provided, as it is rarely convenient to place the constant-tempera-

ture device close up to furnace. Where a millivoltmeter is used, however, this introduces further resistance and it is therefore necessary to periodically ascertain whether the resistance of the extension leads has changed. For this purpose a method similar to that shown in Fig. 3 for measuring the potential drop in the copper lead wires may be used.

With base-metal thermocouple and lead wires of the same materials as the thermocouple all the way back to the millivoltmeter, the cold junction is, of course, located at the binding posts of the latter and variations must be allowed for, as also variations in the resistance of the leads brought about by temperature changes.

*Checking Required With the Potentiometer System.*—When using the potentiometer system all resistance checks are omitted, since no current flows through the thermocouples, lead wires or galvanometers when a balance is obtained, at which time the reading is taken. If the resistance of this circuit should become excessively high, as from defective contact, it will be shown by a lack of sensitivity when making the balance. The thermocouple used with the potentiometer should be checked for the relation between temperature and e.m.f., as already mentioned.

The potentiometer itself may give faulty indications from two causes—variations in internal resistance, as from the failure of imperfectly soldered joints and, second, variations in the electromotive force of the standard cell which is the basis of measurement. Properly made standard cells, free from impurities, retain their characteristics indefinitely. In actual use on the potentiometer they are subjected only to very minute currents, which flow sometimes one way and sometimes the other through the cell, charging and discharging the latter as a storage battery. With two potentiometers, a check may be made by connecting them in opposition. When they are balanced, no current flows, and the settings of the two instruments should agree. If they do not, the one in error can be discovered by comparison with a third instrument. Variations in standard cells should not exceed 0.0001 m.v.

## Choice of Calibrating Equipment.

The character and completeness of the checking equipment will depend upon the nature of the work's equipment with which it is to be used, including the

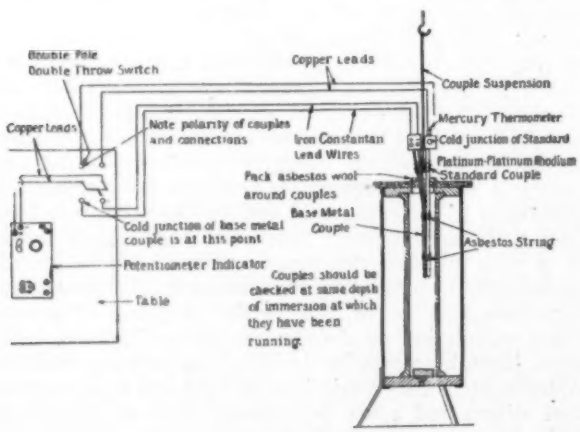

Double Pole Double Throw Switch
Copper Leads
Couple Suspension
Copper Leads
Note polarity of couples and connections
Iron Constantan Lead Wires
Mercury Thermometer
Cold junction of Standard
Platinum-Platinum Rhodium Standard Couple
Pack asbestos wool around couples
Base Metal Couple
Cold junction of base metal couple is at this point
Asbestos String
Potentiometer Indicator
Table
Couples should be checked at same depth of immersion at which they have been running

Fig. 4.

size of the work's equipment and the quality of the results desired. A complete laboratory standard equipment suitable for a large plant doing high-grade work might cost more than the works' equipment of a small plant. For consideration along with the conditions of the individual plant, the following suggestions are offered:

1. A plant requiring in the works 30 or more thermocouples and turning out a high-grade heat-treated product, should have available the following laboratory equipment:

Laboratory standard precision potentiometer with accessories.
Portable double-range potentiometer.
One mounted platinum thermocouple.
Two unmounted platinum thermocouples with accompanying insulators, etc.
Checking furnace with control panel.
Extra standard cell.

2. For a smaller plant the following laboratory checking equipment would give satisfactory results:

Two double-range portable potentiometers.
One platinum thermocouple mounted.
Two platinum thermocouples unmounted, with necessary insulators.
One checking furnace, complete, with panel board.
Note.—If the potentiometer system is in use in the works, one of the above portable potentiometers may be omitted

## Directions for Setting Up and Using the Thermocouple Checking Equipment.

*Preparing Thermocouples.*—The standard thermocouple and thermocouple to be calibrated should be so arranged that their junctions will occupy as nearly as possible the same point in the furnace. That is best assured by tieing the junction of the base-metaal couple against the tube of the standard thermocouple, using asbestos string. The couples may be further tied at several places along their lengths to insure their staying together. The base metal couple should be bare—that is, not inclosed in its tube.

A piece of window chain may then be attached to the thermocouple heads and passed through a pulley secured to a hook or other support in the ceiling, so that the couples hang centrally through the opening in

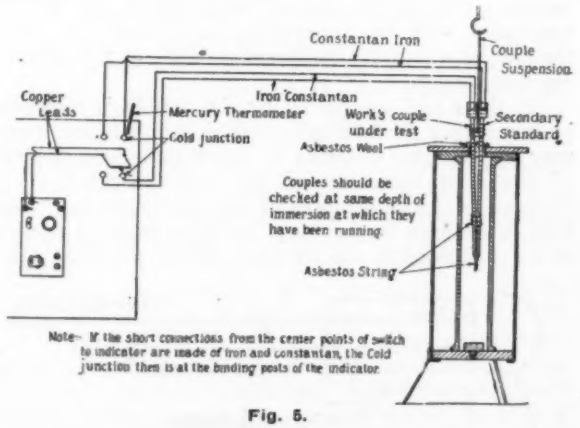

Constantan Iron
Couple Suspension
Copper Leads
Iron Constantan
Mercury Thermometer
Work's couple under test
Secondary Standard
Cold junction
Asbestos Wool
Couples should be checked at same depth of immersion at which they have been running
Asbestos String
Note- If the short connections from the center points of switch to indicator are made of iron and constantan, the Cold junction then is at the binding posts of the indicator

Fig. 5.

the top of the furnace. The couples should not be let in so far that the mercury thermometer of the standard couple will register a high temperature.

*Connecting Thermocouples to Potentiometers.*—Two ways of connecting the thermocouples to the potentiometer recommended by the Leeds & Northrup Co. are shown in Figs. 4 and 5, marked "Set up No. 1" and "Set Up No. 2," respectively.

In (1) the lead wires to the base metal couple are of the same materials as the latter, so that the cold junction of the base metal couple is carried back to a

double-throw switch, connected to the thermocouple by copper leads. The cold end of the standard couple is connected to the double-throw switch by copper leads. Its cold junction is thus in the head where the mercury thermometer is placed.

In (2), suggested for comparing secondary standard base metal couples with works couples, both sets of leads are of the materials used in the couples, thus bringing both cold ends back to the double-pole, double-throw switch. If the leads connecting the lat-

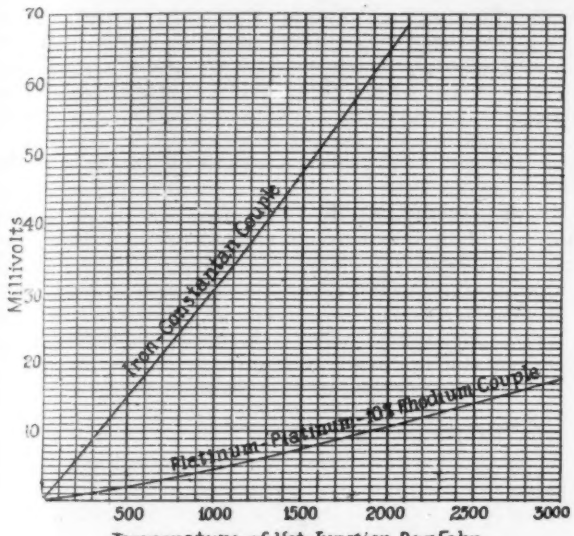


Fig. 6.

ter with the potentiometer are made of the base-metal couple materials, the cold end may be carried back to the potentiometer, and corrections for cold and temperatures can be made directly in the potentiometer itself.

The furnace controller, thermocouples and potentiometer all being thus placed and connected, preparations may be made to run a comparison between two thermocouples.

*Comparing Couples.*—The furnace having been brought up to a temperature of about 1600°, the couples may be lowered into it and the open space around the couples closed with asbestos wool. Hold approximately the temperature desired, taking alternate readings on the standard couple and the couple under test by throwing the switch. Enter the readings in two columns, heading one "X" and the other "Standard." By allowing a regular time interval, 1 or 2 minutes, between readings, the rate of change in temperature may be observed by examining readings. The final reading used for comparison of the two couples should be taken only after the temperatures have remained approximately the same for five or ten readings, the number of similar readings to be taken depending upon the speed with which the couples have been approaching the temperature of the furnace or the speed with which the furnace temperature has been changing. True comparison cannot be made while changes in temperature are going on.

*Cold Junction Correction.*—It is convenient to refer the e.m.f. of thermocouples to some standard cold junction temperature: 0° C. or 0° F. are usually selected for this purpose. With the cold junction at 0°F., the relation between hot junction temperature of a Leeds & Northrup base-metal thermocouple and the net e.m.f. is shown in Fig. 6. It will be seen that the line is nearly straight. The line for a platinum-platinum-10%-rhodium couple, however, is far from straight and it will be seen 10° F. added to the temperature at 1600° F., causes a greater increase in the e.m.f. than 10° added to the temperature at 32° F. with cold junction at 32°F. and hot junction at 42°F; 0.035 millivolts are available for measurement by the potentiometer or millivoltmeter, while if the cold junction temperature is raised to 1590° and the hot junction to 1600° F., the number of millivolts available for measurement will be 0.060. If the hot junction is at 1600° F. and the cold junction at 42° F., the e.m.f. available for measurement is 8.075 m.v., while if the cold junction is at 32° F., the millivolts measured would be 8.110. The difference is 0.035 m.v., or the number of millivolts corresponding to the cold junction at 32° and hot junction at 42° F. If the scale of the pyrometer has been laid out in degrees on the assumption that the cold junction will be at 32° F., whereas it is actually at 42° F., the instrument will read 1594° F. instead of 1600° F.

It will thus be seen that to correct for cold junction temperature, the degrees difference between the standard cold junction temperature, say, 32° F., and the actual cold junction temperature, say, 42° F., should not be added to the number of degrees indicated by the instrument when the cold junction temperature is at 42° F. Instead, the reading should be converted to millivolts, then the millivolts for cold junction at 32° F. and hot junction at 42° F., viz., 0.035, added to the millivolts actually read with cold junction at 42° and hot junction at 1600°, viz., 8.075, will give 8.11 millivolts, which corresponds to 1600° with cold junction at 32°.

If the scale of the millivoltmeter or other instrument is marked in degrees and not in millivolts, the corrections may be calculated as follows:

Divide the e.m.f. corresponding to cold junction at 32° and hot junction at the actual cold junction temperature by the ratio expressing the slope of the curve at the actual hot junction temperature. For example, if it is known that the e.m.f. for cold junction at 32° and hot junction at 42° is 0.035 m.v. and that the rise in e.m.f. for increase of hot junction temperature from 1590° to 1600° is 0.06 m.v., the correction to be added is

$$(42-32)\frac{\frac{0.035}{42-32}}{\frac{0.06}{1600-1590}}=6°$$

and the indicated temperature, which would be 1594°, plus 6° equals 1600°, which is correct.

## NEW PAPER MILL BEING EQUIPPED FOR MOTOR DRIVE.

The Cascade Paper Co. has almost completed a paper manufacturing plant at Steilicoom, situated near Tacoma, Wash. The company is made up of Frank S. Baker and associates. The factory machines and appliances will be electrically operated throughout, requiring a connected load of 600 kw., this amount of power to be purchased from the city of Tacoma, which will deliver it at 2200 volts, three-phase. All electrical installations are being made under the supervision of E. J. Barry, electrical engineer, Tacoma. The equipment is all Westinghouse make. This comprises three 50-kv-a. transformers to step down the voltage to 440 for motor use; and one of 50 kv-a. for transforming it down to 220/110 volts for the lighting circuits; and a number of motors suitably installed for application to the latest methods of paper making.

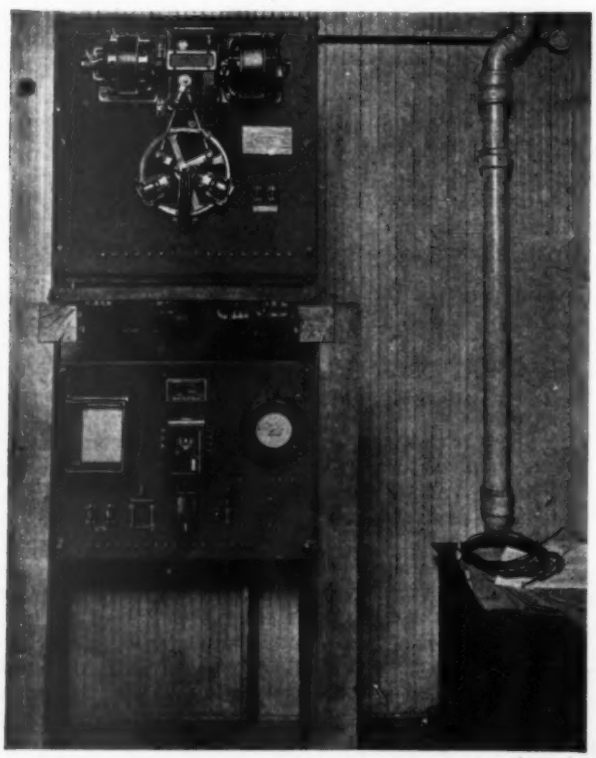
## USE OF ELECTRIC INSTRUMENTS TO MEASURE GAS.

### Description of Gas-Making Process and Application of Thomas Meter as Recently Installed by Laclede Gas Light Co.

The dependence of gas companies on electrical equipment of various kinds is steadily increasing. The gas companies were badly affected by high prices of fuel, labor, etc., during the war and in order to reduce their operating expenses many of them have already adopted their closest competitor—electricity. The load thus established should be very attractive to central-station companies for it is usually a 24-hour demand with a high power and load-factor.

One of the latest electrical appliances designed to be used by gas companies is an electrical instrument for measuring gas called the Thomas meter. One of these meters having a capacity of 750,000 cu. ft. of gas per hour was recently installed by the Laclede Gas Light Co. of St. Louis to measure the total gas manufactured in its station "A." This installation is rather interesting because of the assistance it gives in the operation of the plant and the small space it occupies compared to the equipment it replaces. This particular meter replaces four large wet drum meters, part of one of which is shown in the accompanying illustration which also shows the Thomas meter housing. This housing is located in the pipe line between the purifiers and the storage holder and is known as a "make" meter.

For those who are not familiar with the process of making water gas, it might be well to add here that water gas is made by blowing steam up through an incandescent bed of fuel. The gas driven off is then enriched by passing it into a cylindrical tank filled with hot checker-brick upon which oil is sprayed. The oil vaporizes and is taken up by the gas which goes into another cylindrical tank filled with hot checker-brick to fix the oil into the gas so that it will not be lost or dropped in the gas distribution system. The passing of the gas through the checker-brick for several minutes tends to cool down the checker-brick work so that it must be re-heated. The manufacture of the gas is therefore an intermittent one. The gas flows from the gas machine to a relief holder and from the relief holder through the exhauster, a set of purifiers, the meter, and then into the storage holder.



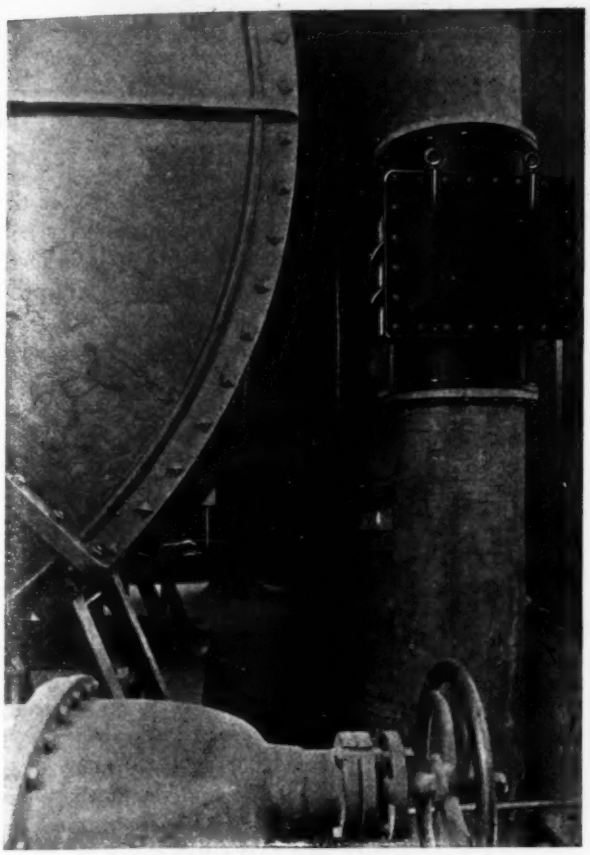
Instrument Board of Thomas Meter Installed by Laclede Gas Light Co. Showing Regulating Panel Above and Graphic and Totalizing Meters Below.

From this, one will see that the amount of gas passing from the relief holder through the purifier and station meter depends upon the speed at which the exhauster is operated. As the relief holder is not of large capacity, the exhauster should be run at such a speed that it will pump an amount of gas equal to the hourly make of the gas machine—that is, the output of the gas machine into the relief holder should equal the amount pumped out by the gas exhauster, with the result that the relief holder will remain practically stationary. If, however, the exhauster is not operated at the proper speeds, the relief holder may be blown, or landed, i. e., if the holder is filled beyond its capacity, the gas will be blown out into the air, or if the exhauster is operating at a faster rate than the gas is being produced, it will be pulled down and the crown of the holder sucked in.

Hence, it will be seen that it is quite important to watch the speed of the exhauster and keep it at its proper value. It is difficult, however, to determine the proper speed, unless the operator can tell just how much gas is being pumped. The result is that most operators run their exhauster fast for a short period until the relief holder is almost empty, and then check the exhauster until it barely turns over, and when the relief holder fills up, the fast pumping is resumed.

The Thomas meter is different from all other forms of gas measuring devices, in that it records the cubic feet of gas per hour in the standard units of 30 in. of mercury and 60° F., without any corrections for pressure and temperature. Further, it records this measure on a graphic chart which shows the amount and variation of gas flow, and on an integrating instrument which shows the total gas during any given period. The graphic chart is therefore a valuable aid to the engineer in charge of the operation of the exhauster. After observing it for a few days and being familiar with the hourly rate at which the gas is made he can adjust the speed of the exhauster so that it will pump an amount of gas approximately equal to the hourly make of the gas machine, thus keeping his relief holder from "blowing" or "landing." The curve drawn by the graphic chart shows the relative speeds of the exhauster.

As was stated, this particular electric meter has a maximum capacity of 750,000 cu. ft. of gas per hour. The housing is 24 in. in diameter and is located in a building which houses four large wet drum meters. These wet meters operating in parallel, have an approximate capacity of 400,000 cu. ft. per hour, and previous to the installation of this meter were used to measure the water gas made at this station. The pressure drop through the new meter at full load is only ¼ in. of water. The regulating and recording panels which are shown in another illustration are located in an office building, about 150 ft. away from the meter room where they are accessible to the superintendent who can see at all times, from the graphic chart, just how much water gas is being made at the



Housing for Meter in Pipe Line.

station. In order to conserve space, the regulator is mounted upon a framework above the panel.

Briefly, the principle upon which the Thomas electric meter operates is as follows: The direct measurement of the gas in standard units is accomplished by warming it just two degrees with an electric heater as it flows through the meter and measuring accurately the quantity of electricity required to do this warming. If just enough heat is introduced into the flowing stream of gas to warm it two degrees, a measure of this quantity of heat constitutes a measure of the rate of flow of gas in standard cubic feet regardless of the existing pressure, temperature, or volume of the gas. The necessary heat is furnished by an electric heating coil and the amount of current necessary to raise the gas two degrees is regulated by two electrical thermometers. In the accompanying illustrations, the graphic meter is located on the left-hand side, and the integrating meter on the right-hand side of the instrument panel. These meters record the gas in standard units of 30 in. of mercury and 60° F. The entire equipment was furnished and its installation supervised by the Cutler-Hammer Manufacturing Co.

## RADIO COMMUNICATION FOR PRESIDENT WILSON EN ROUTE TO FRANCE.

### Details of Elaborate Arrangements Made to Keep President in Communication with United States and France.

President Wilson was in constant communication with the United States and France during his entire voyage from the United States to France through the U. S. S. *Pennsylvania's* powerful radio transmitting and receiving sets. The Annapolis high-power transmitting station, transmitting on 16,900 meters, the high-power transmitting set at New Brunswick, N. J., transmitting on 13,000 meters, the high-power transmitting set at Tuckerton, N. J., on 9200 meters and the high-power transmitting radio station in Lyons, France, on 15,500 meters were used for communications to and from the President.

The President on board the U. S. S. *George Washington* was convoyed by the U. S. S. *Pennsylvania* (which is the best equipped ship afloat for signaling purposes in regard to radio communications) and five torpedo-boat destroyers. The *Pennsylvania's* radio equipment consisted of the following apparatus: One 30-kw. Federal arc transmitter which was used for transmitting messages to the United States and France on 3600 meters, one 10-kw. Lowenstein spark transmitter, transmitting on 600 and 952 meters which was used for intermediate communication with low-power coastal stations, one short-range radio telephone transmitter, transmitting on 297 meters and one vacuum-tube short-range transmitting set, transmitting on 450 meters which were used for intercommunication between the U. S. S. *Pennsylvania* and U. S. S. *George Washington.*

The *Pennsylvania* transmitted messages direct to the United States up to a distance of 2500 miles. Communications with Lyons Station, France, was established long before the *Pennsylvania* was beyond communication range of the United States.

The *Pennsylvania* has six receiving booths which were able to receive on 8 different tunes simultaneously as follows: One booth guarded Annapolis or New Brunswick tunes 16,900-13,000 meters, one booth guarded Lyons tune 15,500 meters, one booth guarded Tuckerton's tune 9200 meters, one booth guarded 4000 meters (the standard arc calling tune), one booth guarded 450 meters for the U. S. S. *George Washington* vacuum tube transmitter tune and one booth guarded 297 meters (the radio telephone tune). One additional operator guarded 600 and 952.

The radio stations at Otter Cliffs, Maine, and Lyons, France, were used to receive messages from the President, transmitted by the *Pennsylvania.*

The *George Washington's* radio equipment consisted of the following: one low-power spark transmitting set, one 16,900 long-wave receiving set, one short-wave 600-meter spark receiving set, one short-range radio telephone transmitting and receiving set, one vacuum-tube 450-meter transmitting and receiving set. The U. S. S. *George Washington* was able to intercept messages transmitted by the Annapolis or New Brunswick stations and guard 600 meter (commercial calling, and emergency tune and the radio telephone and vacuum tunes) simultaneously. Messages for the President transmitted from the United States by the Annapolis, New Brunswick, Tuckerton and the Lyons Station were received by the U. S. S. *Pennsylvania* and relayed to the *George Washington* by means of radio-telephone and vacuum-tube transmitting sets simultaneously.

The messages from the President destined to United States or France were sent from the *George Washington* to the *Pennsylvania* by the vacuum-tube or radio-telephone set and were relayed by the *Pennsylvania's* high-power arc transmitter direct to the United States, Lyons or Brest, France.

The radio communication was directed by Commander H. W. McCormack, U. S. N., Fleet Radio Officer; Lieutenant S. V. Edwards was in charge of the radio of the *Pennsylvania.*

# Editorial Comment

## Industrial Electropyrometry

THE electrical method of measuring temperature, in any of its forms, has made very rapid headway in recent years as pyrometric methods have been improved and as more severe commercial demands have increased the importance of close and accurate knowledge and control of temperature. Electropyrometry is now often employed in industries where other methods would suffice, because of its reliability, comparative immunity from human error and simplicity; and then it is used in scientific and commercial processes where no other method would suffice because of inherent difficulties, such as chemical action, presence of fumes, etc., and financial reasons.

In the steel industry electropyrometry has largely replaced haphazard methods of determining temperature by the eye because of the necessity of producing a uniform product. So also in the production of ceramics, as for insulators and similar important articles. And the list could be multiplied where high temperatures are involved and close accurate temperature is vital. However, electropyrometry is not confined to the high temperatures alone. Many of the central stations have long used thermocouples and exploring coils for determining "hot spots" in cables, for making heat runs on various apparatus where thermometers would be impossible or inaccurate. Most of the large generators and transformers of today are equipped with exploring coils or thermocouples for determining the temperature of their windings.

In the use of thermocouples and pyrometers, delicate apparatus at best, and invariably subjected to severe usage when employed commercially, errors are apt to occur, and these must be combated by regular routine testing as with any other instrument or measuring device unless the product produced or the prestige of pyrometry is to suffer. Checking up the calibration may involve eliminating errors due the thermocouple, to the pyrometer or the leads connecting the two. As in most cases of meter or instrument testing, the check is made against a standard, which in turn is checked sufficiently frequently against a primary standard to assure its accuracy.

Elsewhere in this issue appears a simple and broad, practical discussion of the various errors that may enter into temperature measurements made by pyrometer and thermocouple, how to segregate and overcome them. As the thermocouple-pyrometer has come so widely into commercial use, outside of those applications where an understanding of electricity is implied, it is of great importance that the methods of calibration or checking thermocouple pyrometers be simple and readily accomplished, since these are factors that may decide whether industrial electropyrometry be a success or failure in any installation. It is believed, therefore, that a discussion of this subject will prove of value to many, of interest to all because of its commercial and timely interest, and prove beneficial to those industries where accurate knowledge of temperatures is needed for success.

As pyrometry is usually only a means to an end, always so in industrial processes—the production of steel or porcelain or similar product of uniform quality—it is readily appreciated that pyrometry is liable to be neglected, and in any case receive less attention and consideration than its importance warrants. Simple test methods carried out simply, and compact equipment requiring a minimum investment and knowledge of the theory involved should go a long way toward contributing to greater accuracy in electropyrometry and greater commercial satisfaction.

The testing and meter departments of many of the larger central stations calibrate and repair the instruments of industrial concerns in their territory, customers and otherwise, at a cost much below that which could the owner of the instruments, and more accurately. It occurs to us that the checking of pyrometers and thermocouples might prove a further desirable undertaking for these utility departments, and one that might improve their load-factor, produce a small revenue and tighten the bonds between the utility and industries in its territory.

## A Big Wiring Job

ONE of the normal activities of peace time has been that of building houses and structures. During the past year especially, and to a lesser extent during the previous twelve months, the building trades suffered acutely from high labor and materials costs and labor shortages, restrictions and embargoes. Now that conditions are approaching more nearly normal, one may expect the building trades to gain impetus and make up for time lost. This should be more marked since there is a very real shortage of buildings of certain classes.

According to an authoritative source, there is a normal construction requirement of 385,000 residences per year. During the past four years, actual construction has been so far below normal as to produce a shortage of 700,000 residences. This means that the building interests of the United States must construct 700,000 residences before they can return to normal conditions, which require 385,000 residences each year plus a normal increase in proportion to the growth of population.

It is conservatively estimated that only 20 per cent of all the buildings in the United States now accessible to electrical current have been equipped to use electricity. The records show that there are 19,000,000 residences in the United States, only 20 per cent of which have been equipped for electricity, leaving 15,200,000 residences in prospect for wiring and as a market for electrical appliances. There are 300,000 manufacturing plants in the United States, and on the same basis of estimating 20 per cent electrified, this leaves 240,000 manufacturing plants in prospect for electrical equipment.

Every country will, eventually, make up for lost time of itself or with assistance from other nations. Meanwhile, the United States, coming, as it has, out of the war with the least dislocation of industry, labor and inconvenience of all the belligerents, should be expected to readjust itself the most rapidly, making up for the past and profiting by the experiences of the war. The construction of buildings, residences and factories should be made with provision for eventual if not immediate electrification. There are too many old structures unwired for electricity in existence now without perpetuating the crime.

Electricity has proved itself too well as to convenience, health, economy and comfort, in residence and factory, not to be included as an adjunct to every modern building. It is to be hoped, indeed, that all the structures within reach of electricity supply to be erected in the course of the next year will be modern in the true sense, which means wired for electric lighting, with sufficient outlets judiciously located to permit the use of the popular, nay, necessary, electric appliances such as the washer, iron, sewing machine motor, vacuum cleaner and portable lamp. And more, in those localities and neighborhoods where indicated, electric ranges, heaters and cookers should be provided for before the buildings are erected instead of afterwards. A residence in our cities if not wired is not modern and is handicapped in the way of renting and as a revenue producer.

It is to be hoped, indeed, that the Society for Electrical Development, the National Electric Light Association and the contractors' organizations will keep in touch with civic authorities, architects and building authorities and press the creed of the house wired for electricity.

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## *Contracting, Merchandising and Jobbing*

FOR the electrical contractor, dealer and jobber the past year was a difficult one, because conditions were so uncertain and unfavorable. Conservation of capital, shortage of materials and men, lack of work and sales, and high prices, not only reduced business to a low point, but also reduced profits to a minimum. Toward the close of the war conditions began to improve, but for whatever work there was outside of war work competition was keen, and had it not been for close co-operation among the various contractors' associations conditions would have been worse than they were.

Being subjected to unfavorable conditions from all sides, the contractors have turned their attention to a study of conditions under which they do business, and internal conditions of their business. The wide-awake contractors have studied their situation, and improved methods have resulted that bode well for the future. Contractors and dealers have come closer together, and the last year proved beyond doubt the value of organization and co-operation, without which many of the smaller concerns would have gone to the wall. Great advance has been made during business inactivity toward placing the electrical contracting business upon a sound working basis. It may be said that scientific methods are taking the place of haphazard. During the year the Chicago Electrical Estimators' Association has issued some important data on labor costs and methods of determining the overhead expense that places these often ignored subjects upon a proper basis.

The electrical jobbers likewise passed through a stormy time, particularly during the early part of the year. The elimination of the middleman's profits as encouraged by the Government, became a popular sentiment, and bade fair to make the jobbers taboo. Inability to obtain stocks because of the priorities list and the classification of many of their products as non-essential, coupled with small demand, for a while added to the predicament.

The trade acceptance made healthy headway in the electrical contracting and jobbing fields. Banks quite generally took it up and contractors, dealers and jobbers taking advantage of it report favorably. The banks, of course, favor the acceptance, and indications are that the wider its application and more universal its use the more beneficial it will be for those using it. It is undoubtedly a fact that during the period of readjustment now before us, while so many contractors and dealers are getting back to a peace basis, the trade acceptance will materially assist them to do business upon a scale not otherwise possible without jeopardizing the safety of their business.

The electrical dealer may well view with alarm the rapidly increasing extent to which the hardware, department and drug stores are taking up the sale of electrical appliances of every sort. These merchants handle the electrical appliance as a side line, hence place reliance upon a quick turnover and are satisfied with a smaller profit than where its sales represent the chief source of revenue. Moreover, these merchants find a greater number of customers buy electrical appliances since they come to the store for some other purposes, a class of sale that in no case would enter the electrical dealer's store. One of the important problems of this new year, one of the pressing problems for the electrical dealer, is that of taking steps to retain and not lose the trade of the electrical appliance.

# Week's Events

## *International General Electric Organized—Reconstruction Plans for War-Devastated Countries—Other News*

### INTERNATIONAL GENERAL ELECTRIC CORPORATION FORMED.

**New Corporation with Gerard Swope at Its Head to Push Foreign Sale of American Electrical Machinery and Apparatus.**

Announcement is made of the organization of the International General Electric Corporation, to push the sale of American electrical equipment in all parts of the world. Gerard Swope has been elected president, having resigned as vice-president of the Western Electric Co., Inc., to enter upon this great export undertaking. Readers of the ELECTRICAL REVIEW will recall Mr. Swope's extended trip through the Orient early in the past year, and his first-hand knowledge of conditions there will be an important element

Gerard Swope, President of International General Electric Corporation and Until Recently Vice-President of Western Electric Co., Inc.

in the success of the new corporation, which has abundant resources to bring into all foreign markets electrical goods "Made in U. S. A."

### FUTURE WARSHIPS TO BE PROPELLED BY ELECTRIC DRIVE.

**Recent Tests on New Dreadnought, New Mexico, Prove Superiority of This Method of Propulsion.**

All new capital ships of the American navy will be equipped with electric propelling machinery according to disclosures made recently to the House Committee on Naval Affairs by Josephus Daniels, Secretary of the Navy. This decision is the result of exhaustive tests made with the new electric equipment installed on the dreadnought, *New Mexico,* the latest addition to the navy, which proved conclusively the wonderful possibilities of this method of propulsion. It is further claimed that electric propulsion furnishes American fighting craft with a driving power superior to that of any other navy in the world.

Until recently the method considered most efficient for driving propellers was to connect a long propeller shaft through suitable reducing gears to a steam turbine located near the center of the boat. Many difficulties were encountered in this method on account of the inability of the turbine to maintain its efficiency at lower speeds, the tendency of the long propeller shafts to break and the concentrated weight of the machinery.

Electric drive, using a turbo-generator located as close as possible to the boilers to furnish the power for motors located in the stern of the vessel by which the propellers are driven has been advocated by many engineers for several years as the proper solution of these problems. Prior to the installation on the *New Mexico* this method was tried out with considerable success on many smaller ships. In spite of this however, considerable opposition was encountered when, in 1916, it was decided to equip capital ships in this manner and it was only by the insistence of Secretary Daniels and others that this opposition was overcome.

The machinery on the *New Mexico* is designed to develop 26,500 hp. at full speed, which it was expected would give the ship a speed of 21 knots. She actually developed more than 31,000 hp. and maintained for four hours a speed of 21¼ knots—and this when running at a displacement 1000 tons greater than her design called for. If she had been tried at her designed displacement, as is customary with all new ships, she would have made 21.5 knots, without any trouble whatever; and, what is still better, she could have kept up this speed as long as her fuel lasted, for, like all our later dreadnoughts, she is an oil burner, and there would be no reduction in speed due to the necessity of cleaning fires, which must be done in coal-burning ships after a run of four hours at top speed.

When the contract for the machinery of the *New Mexico* was entered into, it was stipulated that, in addition to being capable of developing the maximum power, it should also give an economy at cruising speed very much superior to that obtainable with the turbine installations that had previously been used, and this stringent requirement also was met. As a matter of fact, the New Mexico will steam at 10 knots on about 25% less fuel than the best turbine-driven ship that preceded her.

It is contended that this new equipment is more economical of fuel, develops greater power, is more mobile and is less easily put out of commission than the former equipment. It is approved by all the great naval experts and advisers, including the General Board of the Navy.

## PLAN INTRODUCED FOR RECONSTRUCTING WAR DEVASTATED COUNTRIES.

**Disposal of Immense Government Stores Embodied in New Idea of Restoration.**

The following plan, the only definite one so far publicly presented for the physical reconstruction of the devastated areas of France and possibly Belgium, Serbia, Poland or Russia, is worthy of special consideration. In addition to providing immediate relief to these stricken countries, this plan also embodies in it a solution of the problem of disposing of the immense stores of material of all sorts which have accumulated in the Government storehouses and those which will be no longer required in plants, etc., which were closed by the cessation of hostilities. The disposal of this material, at such a time as this, when the factories of the country must be kept busy in order to reabsorb the millions of returning soldiers, is a serious matter and this feature of the plan alone makes it worthy of adoption.

John V. Schaefer, president of the Cement-Gun Construction Co., Chicago, has assumed responsibility for the plan and has already presented it at several meetings at which it was enthusiastically endorsed. In recommending the plan Mr. Schaefer points out very carefully the needs of France and the advantages which this country would receive by accepting this idea. One-sixth the area of France has been devastated utterly, and this was the richest part of France. It paid 25% of the sum total of its taxes. In this area there have been destroyed 350,000 homes, 90% of France's spinning and weaving industry, 83% of her pig iron production, 70% of steel production, 70% of sugar production, etc. Of all that, plants, machinery, mines, etc., nothing is left, everything having been carried away or destroyed and must be rebuilt.

In brief, it may be said that there is nothing in the way of building material, equipment, domestic utensils and industrial machinery that is not needed in very large quantities, and at once.

On the other hand, the Construction Division of the United States Army has here in America $30,000,000 worth of building material that has never been used. Included in this is enough lumber to build 60,000 five-room houses. There is about $7,000,000 worth of plumbing, heating, piping and other sanitary and water supply fixtures. When to this is added all the material of like nature from the other departments here and in France, some used and some unused, and to this is added what can be salvaged from demolition of plants, the figures are staggering. The Construction Division alone has purchased bakeries enough to bake 2,000,000 1-lb. loaves of bread daily. It has purchased 100 miles of steam radiators and 1200 miles of plumbing material. Out of one group of temporary office buildings alone there will soon be available 125,000 chairs, 25,000 good office desks, 25,000 typewriters, and electric fans and other office equipment in proportion.

The Construction Division of the United States Army is one of the most effective construction organizations that has ever existed. This organization is composed almost entirely of men from civil life. The organization is still intact and possesses $3,000,000 worth of mechanical construction equipment with the operation of which it is experienced. Its labor, however, is nearly finished and within a few months all of this will be disbanded. If this organization with its equipment could take hold of the rebuilding of France as it took hold of the building of our cantonments, terminals, etc., it should be of the greatest possible assistance to French constructors and would be appreciated. Furthermore, the majority of these men would be willing to go to France if they could continue their present organization and be permitted to work by the methods that have proved so successful.

In accordance with these conditions, therefore, it is suggested that the United States Government offer to the French Government:

1. That all the building material and other equipment owned by the United States Government, both here and in France, and purchased for war purposes, be collected. This will include material not yet used as well as all good material salvaged from the demolition of plants built for war purposes. All such material as can be used in reconstruction to be given to France and delivery expedited to the utmost of our ability.

2. That this be considered as a part of the cost of the war to be included as a part of the bill against Germany.

3. That there be sent to France such part of the existing Construction Division of the United States Army as will enable it, in co-operation with French constructors and European workmen, to rehabilitate quickly the devastated portion, bringing to that task the organization, experience and mechanical equipment that has carried through the American construction program.

Such an offer made promptly at this time will be the strongest possible evidence that we are sincere in our expression of the desire that some form of international agreement—call it League of Nations, or by some other term—shall be reached that will bind us together in peace as we have been bound together in war.

## SEATTLE'S PURCHASE OF STREET-CAR LINES ARRANGED FOR.

**Last Obstacles Removed by Passage of Special Ordinances by City Council.**

The City Council of Seattle, Wash., on Dec. 31, 1918, passed four ordinances providing for the consummation of the deal between the city and the Puget Sound Traction, Light & Power Co., under the terms of which the city becomes the purchaser of the company's street-car lines at $15,000,000, payable in 5% utility bonds of the municipality.

The bonds, which are to be a first lien upon the gross revenues derived from operating the street-car system, are to be paid in 18 annual installments, beginning March 1, 1922. Under the provisions of the purchasing ordinance, a contract is to be made for the purchase of power by either party from the other. One of the stipulations is that the Puget Sound company shall clear its street-car property of indebtedness within a specified time limit, this indebtedness being represented by company bonds covering its interurban electric lines running from Seattle to Everett and from Seattle to Tacoma, as well as the local street-car lines being sold.

A friendly suit has been instituted, by agreement between the city and the company, whereby the validity of the city's utility bonds may be passed upon by the State Supreme Court.

In a referendum to voters at the November 5 election, the proposal to purchase the street-car lines was carried by a vote of 29,726 to 8309. The initial action

in favor of purchasing this property arose as the result of war emergency conditions when traffic demands presented some perplexing problems. The suggestion to purchase the car lines came originally from R. H. Thomson, a member of the City Council and formerly city engineer. The plan was vigorously supported by Mayor Hanson and other members of the Council. One of the conditions that made unified action and co-operation in traffic matters difficult was the fact that three different street-car systems were in operation in the city—that of the Traction company, the Rainier Valley line and the municipal lines, the first named being of principal importance as a traffic factor. By reason of the pronounced municipal spirit prevailing in Seattle, and the long record of inharmonious relations existing between the city and the Traction company, it is believed the company is well satisfied with the sale about to be closed.

The street-car property thus to be acquired by the city comprises 194.8 miles of electric car tracks, 8.6 miles of cable tracks; 447 passenger cars, 27 motor-equipped freight and work cars, 36 similar cars without motors; all the trolleys, span wires, poles, signaling apparatus, switches and other equipment. It includes seven car barns, three cable stations, freight sheds and terminals, large car-repair shops, together with stores and supplies.

It is anticipated that the property will be turned over to the city in February, and will be operated under direction of Thomas F. Murphine, superintendent of utilities.

## NEW YORK ILLUMINATING ENGINEERS MEET.

The January meeting of the New York section of the Illuminating Engineering Society was held Jan. 9 at the Engineering Societies Building. Two papers on lighting were presented, both of which were very interesting.

"Urban Rapid Transit Lighting" was the title of one of these papers delivered by Clifton W. Wilder and Albert F. Allen of the Public Service Commission of New York. In addition, W. F. Little and A. C. Dick of the Electrical Testing Laboratories explained the proper lighting intensities for hotel rooms.

## ELECTRIC POWER IN COAL MINING GAINS FAVOR.

"With a view of saving much of the coal wasted in operating by steam power, the anthracite industry begins the new year with a purpose to install more and more electrical equipment in and about the mines," reads a statement issued by the Anthracite Operators' Bureau of Information.

"Electricity is a great aid and seven distinct improvements have been perfected and installed for the working forces. They include the practical completion of an approved list of portable electric mine lamps, flame safety lamps, methane detectors, electrical rules for mines, the perfection of a suitable mine-lamp cord, a new rescue lamp and a permissible flash lamp.

"In mining and preparing anthracite with steam power, 10% of the coal lifted to the surface is required for fuel. The percentage runs even higher in some mines. Only about one-ninth of the coal now used to operate the anthracite workings would suffice, if electricity replaced steam entirely.

"Specifically it would take about 1,000,000 tons of coal to generate enough electric power to operate the entire anthracite industry which has been consuming up to 9,000,000 tons per annum in its operations. A complete change over from steam to electricity, which is taking place as fast as the new capital investment can be made and the machinery obtained, would thus add about 8,000,000 tons per annum to the total amount of anthracite for the public."

## GENERAL ELECTRIC TO REINSTATE HONORABLY DISCHARGED SOLDIERS.

A broad-gauged policy has been laid down for the General Electric Co. by its president, E. W. Rice, Jr., as to the employment of the nearly 8000 men who left its service to join the army and navy. These men on being honorably discharged from the national service will be placed wherever possible in the positions in the departments that they had left. Credit for continuity of service in the company's employment record will be given to these men, including the time spent in the military and naval service just as if they had worked continuously for the company. The re-employment of men disabled in military service will be directed by special committees to be appointed. The company has decided to urge the many new employes that were taken on in the last year or so to return where possible to their former places of employment. The general policy is that the first duty of the company is to provide employment for the men who gave up their position to serve their country.

## WESTERN ELECTRIC TAKES BACK EMPLOYES RETURNING FROM SERVICE.

The Western Electric Co. is one more of the large corporations which is recognizing its responsibility to its employes who were granted leaves of absence to enter military service, and in a notice published in the current issue of the *Western Electric News* it indicates that it will undertake promptly to assign to work for which their previous experience qualifies them, and at a rate of pay being paid for such work, all employes who were given leaves of absence and who have been honorably discharged from the service.

If it is not possible for the company to assign these returning soldiers to work immediately, they will be placed on a preferred list until such time as business conditions make it possible for the company to take them back. During their continuance upon this preferred list they will enjoy the same rights with respect to the company's benefit plan for employes as during their period of military service and they may also take other employment. The Western Electric Co. had a total of 4936 men in service.

## CUSTOMERS WISH CENTRAL STATION "MERRY CHRISTMAS."

That at least some public utility companies are getting on the Christmas card mailing lists of their customers is the belief of the Oklahoma Gas and Electric Co. at Oklahoma City. The company this year received a number of these pleasant greetings, addressed to it as a corporation. The thought expressed is typified by one of the cards upon which the customer had written—"Thanking you very much for plenty of gas this cold spell—Merry Christmas."

# Commercial

## *Billing Residence Customers—Public Co-operation Acknowledged—Economy in Cooking—New Electrical Applications*

### QUARTERLY BILLING FOR RESIDENCE CUSTOMERS.

**Philadelphia Electric Company Adopts Money- and Labor-Saving Policy.**

Commencing January 1 of this year the Philadelphia Electric Co. inaugurated the policy of rendering bills quarterly to all residential customers instead of monthly as had been the practice previously. The practice of sending bills to residence customers quarterly instead of monthly is rapidly being adopted as a standard accounting method among public utility companies throughout the country.

The terms of the contract will not be changed, only the minimum charge will cover the three months' period as will the charge for energy consumption. The added charge for failure to pay the bill within the ten-day period allowed will also be calculated on the same basis as during previous years. The new policy aims to reduce the cost of billing residential customers by reducing the amount of work attached to meter reading, billing, receiving payment and bookeeping.

### HONORING VETERANS OF EDISON SERVICE.

**Commonwealth Edison Co. Gives Luncheon to 85 of Its Retired Employes.**

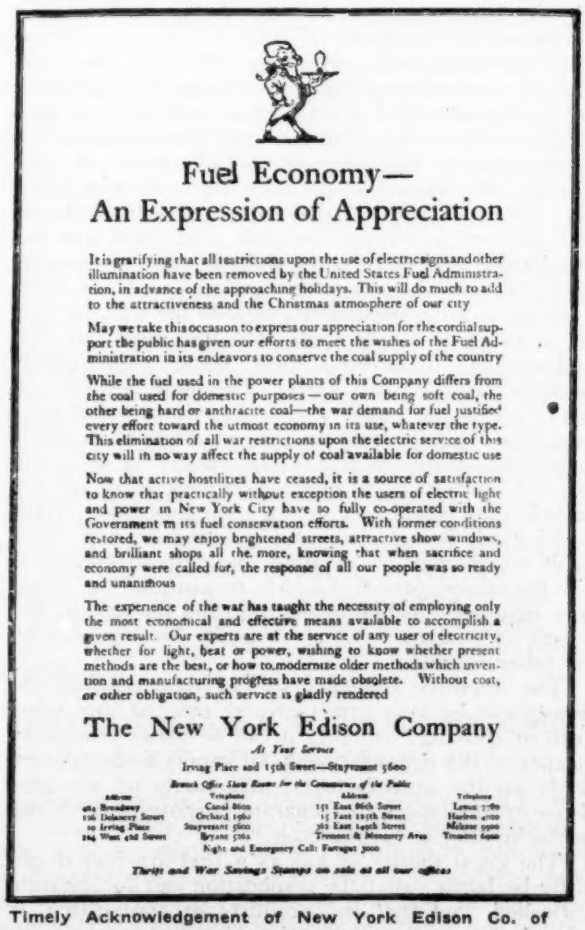
Gray-haired annuitants were the guests of honor at a New Year's Eve luncheon given by the Commonwealth Edison Co., Chicago, on Dec. 31. The beneficiaries of the company's service annuity system are those retired employes who by years of faithful service have earned the privilege of resting in the evening of their days and who are carried on the pension payroll of the company. Such of these men as could attend were the honored guests at the luncheon, and a number of the executive officers, heads of departments and older employes were invited to meet them and swap reminiscences; 85 men were in attendance. The luncheon and reception were given in the new rest room and refectory fitted up for women employes on the eighteenth floor of the Edison Building. The food was cooked by electricity and served by members of Electra, an organization of women employes. Music was given by an orchestra of young men employed by the company.

Letters were read from annuitants who were unable to be present, and a brief but feeling address was made by Samuel Insull, president of the company, who mentioned the fact that he had been president for over 26 years. When he became president there was about $1,000,000 invested in the business; now the investment is over $100,000,000. The speaker dwelt earnestly upon the duties of employes of public utility companies to the public. "Satisfactory service properly rendered at a minimum cost" is what the utility companies should give the public, he said.

The service annuity system has been in existence for seven years. Employes make no contribution whatever to this fund, which is a voluntary recognition on the part of the Commonwealth Edison Co. that long-time employes are entitled to some reward for faithful service in addition to their regular wages.

### NEW YORK EDISON PUBLICLY ACKNOWLEDGES CO-OPERATION OF CUSTOMERS

The New York Edison Co. has taken, most appropriately, the holiday season to make an announcement to its customers and others, in the form of a public expression of appreciation for the support which has been given the company in connection with the fuel conservation movement during the past year. This announcement, shown in the accompanying illustration, has been printed in all prominent dailies in the city, being of a size about 6¼ by 10 in., and attractively arranged to appeal to the eye. The characteristic "Edison Man" is used in leading position with the



Fuel Economy—
An Expression of Appreciation

It is gratifying that all restrictions upon the use of electric signs and other illumination have been removed by the United States Fuel Administration, in advance of the approaching holidays. This will do much to add to the attractiveness and the Christmas atmosphere of our city

May we take this occasion to express our appreciation for the cordial support the public has given our efforts to meet the wishes of the Fuel Administration in its endeavors to conserve the coal supply of the country

While the fuel used in the power plants of this Company differs from the coal used for domestic purposes — our own being soft coal, the other being hard or anthracite coal—the war demand for fuel justified every effort toward the utmost economy in its use, whatever the type. This elimination of all war restrictions upon the electric service of this city will in no way affect the supply of coal available for domestic use

Now that active hostilities have ceased, it is a source of satisfaction to know that practically without exception the users of electric light and power in New York City have so fully co-operated with the Government in its fuel conservation efforts. With former conditions restored, we may enjoy brightened streets, attractive show windows, and brilliant shops all the more, knowing that when sacrifice and economy were called for, the response of all our people was so ready and unanimous

The experience of the war has taught the necessity of employing only the most economical and effective means available to accomplish a given result. Our experts are at the service of any user of electricity, whether for light, heat or power, wishing to know whether present methods are the best, or how to modernize older methods which invention and manufacturing progress have made obsolete. Without cost, or other obligation, such service is gladly rendered

The New York Edison Company

*At Your Service*

Irving Place and 15th Street—Stuyvesant 5600

*Branch Office Show Rooms for the Convenience of the Public*

| Address | Telephone | Address | Telephone |
|---|---|---|---|
| 382 Broadway | Canal 8100 | 151 East 86th Street | Lenox 7780 |
| 126 Delancey Street | Orchard 1980 | 15 East 125th Street | Harlem 4000 |
| 10 Irving Place | Stuyvesant 5600 | 362 East 149th Street | Melrose 9900 |
| 104 West 42nd Street | Bryant 5262 | Tremont & Monterey Aves | Tremont 6900 |

Night and Emergency Call: Farragut 3000

*Thrift and War Savings Stamps on sale at all our offices*

**Timely Acknowledgement of New York Edison Co. of Customers' Co-operation.**

heading, "Fuel Economy—An Expression of Appreciation," well displayed with harmonious balance and good use of white space.

The announcement sets forth that it is a source of pleasure to the company to know that practically all users of electric light and power in the city co-operated with the Government in its fuel conservation efforts. Mention is made of the satisfaction to all that the restrictions upon the use of electric energy for the operation of electric signs and other illumination have now been removed by the United States Fuel Administration, as this is a factor which unquestionably helps to add to the attractiveness and gaiety of the holiday season.

Taking this opportunity of saying a word for Edison service and facilities, the company explains that its experts are at the service of any user of electric energy, whether for light, heat or power, with ability to show whether present methods are the best, or how to modernize older methods which invention and manufacturing progress have made obsolete.

## FUEL ECONOMY IN COOKING.

**Comparisons of Cooking by Coal, Gas and Electricity Favor Latter.**

Some criticisms and remarks recently made by A. H. Barker in a series of lectures before the University College, London, on "Fuel Economy in Cooking Apparatus" should be of interest to us over here. Mr. Barker is now engaged in carrying out extensive experiments and research on behalf of the National Housing Committee and the Department of Scientific and Industrial Research.

In comparing the advantages of coal, gas, and electricity for cooking, the author states that the gross cost of heat obtained directly from solid fuel unquestionably is lower than that either of gas or electricity, notwithstanding that the actual efficiency of the domestic coal range is less than 3%. Its use, however, is attended by many disadvantages from which both gas and electricity are free, and these are too well known to need recapitulation. As at present employed, gas involves a tremendous waste of heat. A supply of air is needed, not only to the burning gas, but to remove and dissipate into the open air the products of combustion, these being great disadvantages attended with waste. The mere necessity to supply air to the burning gas in itself prevents anything like real economy in the use of heat in small apparatus. With electricity the energy is delivered into the kitchen, as it were, in tabloid form, all the waste having taken place during its manufacture. With electricity it is not only easy to produce any exact result which may be required, but also to control it with the utmost precision and to measure all the quantities involved—including the heat and the power, etc. —with an exactitude which is totally unobtainable by any other means.

The scientific efficiency of electrical cooking obviously can be very much greater than of any other form of cooking; whether it can be made practically cheaper or not depends partly on supply undertakings, partly on the manufacturer, and partly on the provision of appliances for separate purposes, but chiefly on the intelligence of the cook.

The great merits of gas as a fuel are that it can easily be burnt; that the combustion can be instantly controlled, and that the products of combustion, if properly burnt, do not contain either soot or any poisonous product. This enormous advantage, which ought to put solid fuel altogether out of court for a scientific process like cooking, largely is neutralized by two causes, firstly the absurd price which the gas companies charge for gas for cooking purposes, and secondly the crude conception of a gas cooker which up to the present has commended itself to the makers. The waste involved in the use of gas for oven-heating in the common manner is similar to that involved in the use of a solid fuel. In this case, extreme simplicity is the root idea. A gas oven is nothing more than a metal box, open at the bottom, with a hole at the top, and with the gas flames burning under it at the bottom.

When gas is burnt for perfect combustion, the temperature attained would be several thousand degrees Fahrenheit. Such a temperature would burn up any food it touched. It is found in practice that when a gas flame is allowed to burn freely open to the cold air which surrounds the burning gas on all sides, the temperature attained by the wasteful mixing of the cold surrounding air (by the naturally induced convection currents) with the products of combustion produces a temperature just about manageable for direct contact with the food. This mixture is allowed to pass upwards into the oven and to escape at the top.

It is believed the best that science has been able to do up to date, or rather it is the standard general method. There are better methods, but they have not been generally adopted, partly because the apparatus required for better methods is more expensive, and partly because the gas companies have millions of dollars worth of gas cookers of this crude type hired out with their customers, and if reasonably economical methods were adopted all these would have to be thrown on the scrap heap. In the author's opinion, one of the causes why gas cookers are so inefficient is that they must be simple, durable, and inexpensive. The process of applying electrical energy for the same purpose is much more easy and manageable, essentially because it can be used in small quantities, and because it is not necessary to provide air for combustion. This is the essential feature which must in time bring electrical cooking into much more common use than it is at present—so soon as supply undertakings see the folly of charging five times as much for the current as it ought to cost. All that is necessary is to provide a relatively cheap power supply, and with reasonably careful use appliances for electrical cooking are certain to displace all other kinds of cooking plants. Electrical elements can easily be fixed in a completely closed space, and the escape of heat is then only a matter of guarding against easy transmission by any of the well-known systems of lagging.

Turning to the waste in boiling by gas, the author points out that free access for cold air is allowed round each one of the gas jets in a boiling ring, thus reducing the attainable temperature by a thousand degrees or so, and causing the products of combustion, which should be extremely hot, to be little more than lukewarm. It needs only a small amount of thought to see the excessive extravagance of all these processes. There is not one of them, probably, that has a usual efficiency greater than 20 or 25%. Heated or vitiated air is allowed to escape into the air of the kitchen, poisoning the atmosphere and making the task of the cook a very heavy one, which is quite unnecessary. Mr. Barker touches lightly upon the relative waste of food as between a ventilated gas oven and a completely enclosed electric oven. Of the total weight of a joint, perhaps 10% is lost in a completely enclosed oven, 15% in a coal oven, and 20% in a freely

ventilated oven. This would be a serious matter if what is lost is actually an important part of the meat, but on this point no final pronouncement has been made. Has what is lost a food value, or is it only water, and if so, is there any real loss in the quality of the food owing to the evaporation of this water? A certain reply on these questions in one sense might involve a very serious reflection on a gas oven. Whatever the reply it could hardly be unfavorable to the electric oven.

It may be, also, that there is a real difference between the effect of radiated heat, as in an electric oven, and convected, as in a gas oven. On all such questions there ought to be much more definite information than actually is to be easily found.

Experts in cookery are strongly of opinion that it is a national failing to cook at too high a temperature, which tends to harden the food and to spoil it from the point of view of nutrition and taste. This point should be considered carefully, because this fact is the cause of an enormous waste not only of fuel, but also of food. If ovens are maintained at 400° when there is no need for a temperature higher than 330°, 50% of the fuel burned is probably wasted. Further, if the cooking process can be completed at a much lower temperature than is customary, it is evident that the residual heat in the apparatus could be utilised to complete the process without wasting any more fuel.

## LABOR-SAVING ELECTRICAL APPLIANCE HOLIDAY FAVORITES.

**Washing Machines and Vacuum Cleaners Head List. Toasters, Percolators, Irons and Portable Lamps in Demand.**

Following the signing of the armistice, preliminary to a treaty of peace, savings banks throughout the country generally, experienced an increase in their deposits. The removal of strain and anxiety manifested itself in other directions and involved the holiday trade. The volume of business transacted in electrical appliances was in excess of the 1917 season. Throughout the system of the Public Service Co. of Northern Illinois this was marked, especially in the salesrooms in the larger towns and in the more thickly populated districts.

The articles most in demand were labor-saving devices—washing machines and vacuum cleaners. But in all, toasters, percolators, irons and portable lamps moved out in large volume. A feature of the business was the sale of numerous small articles whose prices are rather above the ordinary range. Certain novelties which last year were not largely wanted sold quickly. The electric shops and stores in the city of Chicago and vicinity were cleaned out of these ten days before Christmas.

Plans of appliance campaigns during the coming year are already being worked out by the sales department.

## ELECTRICITY FOR WINDING WATCHES REPLACES SEVERAL MEN.

A New York watch repairing concern, where upwards of 700 watches have to be wound daily, recently adopted electric winders. Electricity winds the timepieces more efficiently than human hands and takes the place of several men formerly required for this work.

## DEVELOPMENT WORK OF BYLLESBY INTERESTS DURING YEAR.

To meet the demands for additional electrical energy of war and essential industries during the past year, considerable development work on the part of electric service companies was necessary. Among these is H. M. Byllesby & Co., who despite many handicaps, accomplished much in improving and extending its properties. Upwards of 66,000 hp. in steam turbine units, 254 miles of high voltage transmission line, and many other additions were financed and installed. This construction work, with certain maturing obligations, made necessary financing amounting to approximately $24,500,000 par value in bonds, notes and preferred stock. The new bonds issued totaled $14,569,000, coupon notes $7,953,300 and preferred stock about $1,900,000. This financing was accomplished with the assistance of a number of investment banking houses, and through the bond department of the Byllesby Company, without government aid. New preferred stock and bonds and notes sold locally, or in territories where the companies operate, amounted to more than $4,500,000.

## ELECTROLYTIC EXTRACTION OF COPPER FROM PYRITIC ASHES.

A new method for the electrolytic extraction of copper from pyritic ashes was described recently in *l'Industria*. The method is based on the electrolytic conversion of sulphide or sulphate of copper into cupric or cuprous chloride by the action of chlorine at the anode. If in an electrolytic bath containing hydrochloric acid in solution the anode is surrounded by a mass of pyritic scoria, the chlorine liberated by the hydrogen attacks the oxides, sulphates, or sulphides of copper more rapidly than the oxides of iron, and combines with them to form cupric chloride. The reaction extends to the entire mass of scoria, so that the latter acts as an electrode. The copper loss by this method is said to be only 0.1%.

## MOTOR-DRIVEN MACHINE IMPROVES GARAGE SERVICE.

An American combination burning-in and motor-test machine was recently installed in a garage repair shop at Evanston, Ill. This machine, which is motor driven from the lines of the Public Service Co. of Northern Illinois, saves considerable time in the overhauling of the Ford engine. Before this machine was installed it would take one man about two days and a half to scrape in the bearings and about six hours to run the bearings in after the engine was put together. With this machine the scraping of bearings is done away with, and where it formerly took two days to scrape in the bearings it can now be done in about one hour. The testing only requires about two hours against six.

## SMALL-APPLIANCE BUSINESS ABSORBS 1500 KW. ADDITIONAL IN 1918.

During 1918 electric dealers in cities served by the Arkansas Valley Railway, Light & Power Company, sold 3246 household electric appliances to customers of the company. Of this number 1757 were electric flat irons. This represents an increase of approximately 1500 kw. to the business served by this utility.

# Operating

## *A Simple Chronograph—Preventing Fires in Coal Hoppers —Rewinding Transformers—Overcoming the Evening Peak*

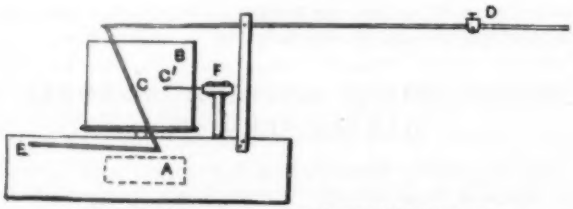
### A SIMPLE CHRONOGRAPH.

**Device Suitable for Determining Rates of Operation of Oil Switches, etc.**

By C. W. MARSHALL.

It is now generally recognized to be essential for all central stations and electric power systems to have accurate data as to the characteristics of their oil switches and circuit-breakers. Data regarding new switches must be obtained from the manufacturers, but older types must be investigated by their owners. The apparatus described has been found very serviceable, and can be thoroughly recommended as a cheap and reliable article, says C. W. Marshall in the *Electrical Review* (London). Practically no skill is required either to build or to operate it.

Referring to the illustration, "A" is a phonograph motor, such as can readily be purchased second-hand for a few dollars, "B" is a drum taken from an obsolete recording ammeter, and fitted on the gramophone record turntable; "C D E" is a three-element lever system. The long arm is made in sections, for convenience in transport. When testing the speed of a switch, the sliding saddle "D" is connected to a convenient point on the switch mechanism, and the length of the lever is adjusted so as to give a suitable travel to the recording pencil which is at "C."




A Simple Chronometer for Central-Station Use.

The drum is then set to revolve at a speed commensurate with that of the apparatus under test, and "opening" and "closing" curves of the switch can be taken as required. Experience has shown that a drum peripheral speed of 50 cm.-sec. gives excellent results with the usual types of oil switch; but even a very cheap motor will drive the drum at 500 cm.-sec. if necessary. A very gratifying feature of the motor is its constancy in speed over long intervals, and cyclic irregularities are quite negligible. This renders it quite unnecessary to fit any additional apparatus to mark the time-co-ordinates directly on the record except in specially important cases. Metallic paper is generally used in conjunction with a silver point, and the records obtained in this way are very satisfactory. The paper is fitted on the drum by two rubber bands, one being at the top and the other at the bottom.

The apparatus could be made more compact if spiral records were considered allowable, as the charts could be put directly on the gramophone turntable. The form described is, however, somewhat more convenient when space-time curves are being differentiated to give velocity-space curves.

The fitting shown at "F" is used for determining the times of action of relays, fuses, etc. The fuse, for example, is connected in series with the energising coil of the electro-magnet. When the current is switched on, the pencil "c'" comes into contact with the revolving drum, and when the current is interrupted by the blowing of the fuse, "c'" leaves the paper. The length of the line is a measure of the time taken to blow the fuse. For convenience in obtaining "fusing-current" "time" curves, the height of "F" is variable.

### PREVENTING FIRE IN COAL HOPPERS.

**Sectionalized or Individual Hoppers Advisable Where Using Soft Coal.**

By M. EASTON.

The coal hopper that extends a sufficient length along the boiler room to serve all boilers along two aisles usually costs less than the hopper installed for each boiler has its own separate hopper.
adjacent hoppers. Moreover, the common hopper serving a number of boilers and their stokers is somewhat more easily filled with coal than is the case when each boiler has its own separate hopper.

The advisability of erecting separate coal hoppers, or at least of equipping a hopper common to a number of boilers with sectionalizing barriers was emphasized recently in a central station containing some thousands of boiler horsepower equipped with underfeed stokers. This plant has taken to a lower grade soft coal from Illinois where it had burned a good grade of clean coal before the zoning and last winter's coal situation occurred. One coal hopper was installed for every six boilers, and had a capacity of more than 2000 tons of coal. The hopper was cement lined.

In preparation for the cold weather and oncoming winter load this hopper had been loaded up to beyond capacity and was replenished daily, so as to allow as much space elsewhere for storing additional fuel. The high temperature beneath the hopper transmitted from the boiler room, the height of the coal in the hopper, and the low grade of coal with its dirt, combined to cause spontaneous combustion of the coal to occur in the hopper. The space above the hopper was cramped and only sufficient space existed to permit one man in an electric hoist to travel backward and forward. However, the heat and smoke given off by the burning coal were such that it was impossible to dig out the fire, which had started in about the middle of the pile and worked both ways.

The burning coal coked as the fire spread up through the pile. Coking and caking together, the coal entered the spouts to the stoker with difficulty, down in the boiler room, causing a smoky room, over-heated stoker retorts, clogged spouts and extreme difficulty in

maintaining stoker capacity partly because of the size of the coal and slowing down of the stokers but chiefly on account of the loss of thermal units in the coal through partial distillation in the hopper. Clinker troubles were aggravated. Ash-handling difficulties multiplied. And considerable annoyance and loss of capacity occurred until eventually the coal had burned itself out.

The above is not confined to one company, but has been the experience of many utilities during the last months who have had to take to low-grade fuels with high dirt content, or mix various coals. However, while spontaneous combustion can be very largely prevented by keeping the coal hoppers from getting hot, by cleaning the coal, not mixing it nor piling it more than 10 ft., there cannot be any assurance that these things can be done. The advisability, therefore, of sectionalizing by steel barriers or walls a coal hopper erected to serve a number of boilers, where low-grade, dirty fuels are to be used is a worthy one. Where a plant is to be built and coals prone to spontaneous combustion are to be used, it would seem worth while constructing a separate and individual hopper for each boiler.

## CONVERTING STANDARD APPARATUS TO SPECIAL PURPOSE.

**Method of Re-Winding Transformers to Give Higher Transformation Ratio.**

Four single-phase transformers rated at 200 kv-a. 11,000/2200 volts were available, but it happened that equipment was needed for stepping down from a 3000-volt line to 65 volts. As no other apparatus was available, the following procedure for adopting the four transformers available was adopted, with success.

The high-voltage coils were made up of pairs of disks; each disk was composed of 67½ turns of ribbon wire, making 135 turns to a pair. These were grouped in quadruple, thus making the high-voltage winding capable of withstanding 2750 volts with a slight amount of overmagnetization that had, however, no untoward effects in producing excessive heating of the iron.

The secondary or low-voltage coils were also wound in pairs of disks with two ribbons in parallel—13½ turns per disk. These were re-wound with the same ribbon, but in quadruple. Care was taken that every wire was made the same length so that no one ribbon should carry more current than another. It follows that the finish of these four ribbons came out at four different points to bring all ends level for grouping. These ends were tailed with very large section copper to insure an equal resistance for each individual ribbon.

All secondary disks were then grouped in multiple.

The end connectors of the primary or high-voltage winding were made by using the original end connectors of the secondary, and the end connectors of the secondary were made of 1¼ in. by 1/16 in. busbar, laminated and riveted to make 1¼ in. by 1¼ in. square.

These changes accomplished the desired result, and without causing any trouble or operative difficulties.

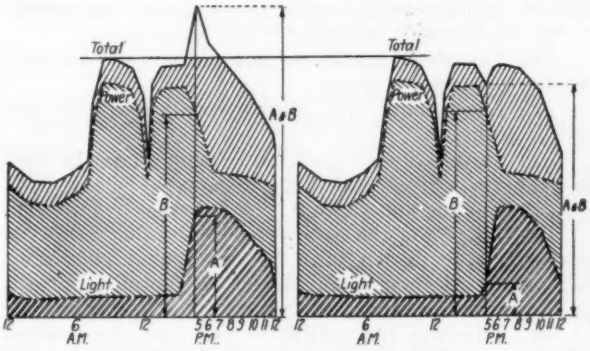
Compressed air from a compressor should not be used for cleaning relays when blowing out the switchboard. Air may be blown into the relays, making them inoperative. A bellows answers the purpose for cleaning the relays.

## STRADDLING EVENING PEAKS MAKES ADDITIONAL CAPACITY AVAILABLE.

**Cessation of Power Load Earlier in Day Beneficial for Reduction of Peak in Evening.**

When generating capacity in the stations of public utilities were overloaded and additional capacity could not be obtained for needed war industries, many of the central-station companies attempted to have the daylight-saving law enforced during the present winter. By so doing the power load would have decreased —which depends upon the clock for commencing and stopping—before the peak due to lighting came on, since this latter depends upon the setting of the sun. In this way considerable capacity would have been available for use, that would otherwise have to be kept in reserve and in readiness for the time of the evening peak when power and lighting loads overlap.

The accompanying curves show what would have been the effect upon the load curve of the Philadelphia Electric Co. of keeping the clock moved ahead one hour. The area shown in white above the "total" line represents approximately 17,000 kw. in capacity that would have been made available for use other than for




**Curves Showing Effect of Overlapping of Power and Lighting Loads Upon Peak Load of Philadelphia Electric Co.**

the peak, had the clock remained ahead during the winter. "A" in both curves represents the lighting load at 5 p. m. clock time. "B" represents the power load at 5 p. m. clock time. "A" plus "B" equals the lighting load plus the power load at 5 p. m. clock time. The curves are typical and apply with modification to most central stations serving mixed load.

However, the clock is not remaining ahead one hour, and there is no indication that such an innovation will come. Nevertheless, there is another way in which the same result can be secured, in part, at least. That is to encourage power users to commence and cease work earlier. The user of power that does this is entitled to lower rates.

## ROUTINE RENOVATION OF TRANSIL OIL.

To discard old transil oil is extravagance when renovation would make it useful again. In the larger stations an oil filter should be installed and the oil renovated periodically. When there are a number of stations scattered over a wide territory a portable filter moved as required is a good investment. It not only reduces the oil bill but lessens the likelihood of dielectric failure and breakdowns due to moisture, and overheating because of dirt and sludging. Oil not longer fit for high-voltage apparatus may be used for apparatus using lower voltages.

# Contracting-Construction

## *Croft Explains Coupling of Wires to Pulling-in Lines—Electrical Inspection Forms—Among the Contractors*

### ATTACHING CONDUCTORS TO FISHING WIRES AND PULLING-IN LINES.

**Use of Fishing Wires and Special Pulling-in Lines—Requirements of the Attachment—Connection to Fishing Ribbon.**

By Terrell Croft.

[*This is the first of several articles that discuss the best methods of connecting the fishing wire or pulling-in line to the conductors to be pulled into a conduit system—a subject not sufficiently known or previously written about. These articles form practically a continuation of the series of seven articles by the same author on methods of fishing conduit which were published in the* Electrical Review, *Aug. 24 to Oct. 5, 1918. The importance of conduit work and the clear style of this well-known writer should make these articles of interest to contractors and electricians.*]

*The Essential Steps in the Installation of a Conduit Wiring System are these:*

(1) Laying out the work from the plans and specifications.

(2) Installation of the conduit tubing and the steel distribution, outlet, and junction boxes.

(3) Fishing the conduit.

(4) Fastening the fishing wire to the electric conductors to be drawn into the conduit, if conditions will admit of their being drawn in thereby, or to a pulling-in line if such is necessary.

(5) Drawing the pulling-in line into the conduit with a fishing line (if a pulling-in line is necessary).

(6) Fastening the pulling-in line to the conductors to be drawn in (if a pulling-in line is used).

(7) Drawing the conductors into the conduit with a fishing line, if this is feasible, or, if not, with a pulling-in line.

(8) Making the splices.

(9) Soldering and taping the joints.

(10) Grounding. That is, permanently electrically connecting the conduit system to some grounded member in the structure in which the conduit system has been installed.

After the work above specified has been completed, it being assumed that the building construction is sufficiently far advanced, the distribution panels and cutouts are placed, the fuses are mounted in them, the circuit wires are connected to the circuit lugs and the lighting fixtures and receptacles are installed and connected. Finally, the service connection is effected and the installation is complete and ready for operation.

*Conductors Are Pulled Into Conduits with Either Fish Wires or Pulling-in Lines,* unless the run is so short and straight that the conductors can be pushed through from one outlet to the other. For runs having but few bends, where the wire to be pulled in is not larger than No. 12 or No. 14 B. & S. gauge, a ribbon fish wire can be used as a pulling-in line after the run has been fished with it. But it is inadvisable to draw in runs which pull hard or runs of heavy conductors with a ribbon fish line. The reason is that the stress thus imposed on the ribbon fish line takes the "life" out of it. When heavy wires are pulled into long runs with a ribbon fishing wire, it loses its original tendency to assume the form of a long straight ribbon and tends to roll and twist into curls. This makes it very difficult to push through a conduit run and for rapid efficient work renders it almost useless. Hence, a pulling-in line of some sort or other, which has been drawn through the conduit with a fish wire, should always be used for drawing in heavy runs.

Regardless of the character of the line which is used as a pulling-in line, the conductors which are to be drawn into the conduit should be attached thereto so that they can be installed with the expenditure of minimum time and effort. In this article will be described the methods that experience has shown to be most effective which are utilized in attaching the conductors to be pulled in to the pulling-in lines or fish wires of the different types.

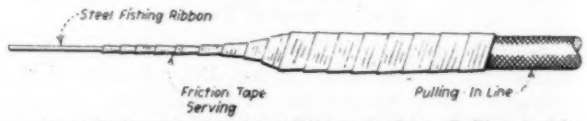



**Fig. 1.—Attachment of Fishing Ribbon to Rope Pulling-in Line Taped Over to Present Gradual Taper.**

*If a Round Galvanized Steel Wire Has Been Used for Fishing,* relatively large conductors can be pulled in with it. There is not the danger with wire of this kind that there is with steel ribbon wire of straining it unduly, because of the greater cross-section of the galvanized wire. Even if the galvanized wire is so stretched as to render it useless as a fishing wire, it can be discarded with little loss.

*The Different Kinds of Pulling-in Lines* may be enumerated thus:

(1) Ribbon fish wire of rectangular section.

(2) Galvanized iron wire of round section.

(3) Cord or rope.

(4) Chain.

While the method of attaching to a drawing-in line of any of the four above types must satisfy the two general requirements enumerated in the following paragraphs, the detailed procedure varies somewhat as will be shown.

*The Importance of a Properly Made Attachment* cannot be overestimated. If the attachment is weak it may fail during the drawing-in process. If it does, the pulling-in line will be drawn away from the conductors when they are partially pulled in. This will necessitate a refishing of the run. Furthermore, if the attachment is not properly made it may either "pull hard"—require excessive force to draw it through—or it may "stick" at some coupling or elbow in the run.

*The Principal Requirements of the Attachment of Conductors to Be Pulled in to a Pulling-in Line* may be enumerated thus:

(Copyright 1918, all rights reserved by the author.)

(1) The attachment should have ample tensile strength.

(2) The attachment should offer minimum opposition to the drawing of the conductors into the conduit.

*The Requirement of Tensile Strength* may be satisfied in an obvious way by so making the connection of the conductors to the pulling-in line that it will be sufficiently strong. This requirement is not difficult to satisfy provided the graphic and written instructions enumerated herein are followed.

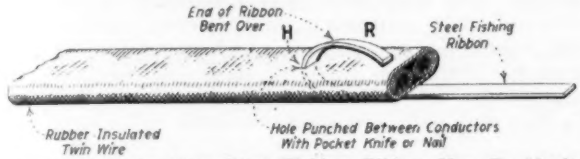



**Fig. 2.—Showing How Steel Fishing Ribbon May Be Hooked Through Twin Wire for Drawing In.**

*The Requirement of Minimum Opposition to Drawing In* can also be met readily by a reasonable exercise of judgment and common sense. The attachment should always "taper gradually" (see Fig. 1). That is, it should be conical in shape from the pulling-in line to the body of the conductors so that the joint will slide easily into the conduit and past irregularities therein without seizing. Preferably it should be a sort of conical wedge. The conical form is made by serving tape over the attachment in such a way that the interstices are filled in.

*In Attaching the Conductors to Be Pulled In to a Ribbon Fish Wire* one of the methods suggested in Figs. 2 or 3 may be used. The simplest attachment, where the run is short and relatively straight and where twin wire is to be installed, is made by hooking the end of the fish ribbon through the outer braid of the twin conductor (*H*, Fig. 2). A slit should be cut through the outer braid about 1 in. from the end of the wire. The end of the fishing ribbon should be bent over and down as at *R*. Then it is hooked through the slit so that it will not catch inside of the conduit. The braid, due to the fact that it is composed of many strands crossing one another, does not tear out readily. Where it is applicable, this method consumes much less time than does one where the "skinned" end of the conductors must be made up in a loop on the end of the fishing wire.

*To Attach Conductors to a Steel Fishing Ribbon for Drawing In* (it is understood that only small conductors—No. 12 or No. 14—for "easy runs" should be pulled in with a fishing ribbon) a loop is formed in the end of the fishing ribbon and a serving of small copper wire is made around the end of the loop. This serving should be soldered for best results. The bare copper conductor ends are then made up into the loop and the whole served with friction tape.

Another attachment to a steel fish wire which may be used where a hard pull is expected can be arranged by (see Fig. 3) forming a loop *L*, 3 or 4 in. from the end of the fish wire and then making up the copper conductor ends *C* in it as shown. The free end of the fish ribbon extends along the conductors and is lashed to them with turns of small-diameter binding wire. The entire attachment should be served with friction tape so that it will offer minimum resistance. As suggested in a preceding paragraph, hard-pulling runs should not be drawn in with a fish wire. Hence, the method of Fig. 3 is not, in general, recommended. It will, however, be found serviceable in an emergency.

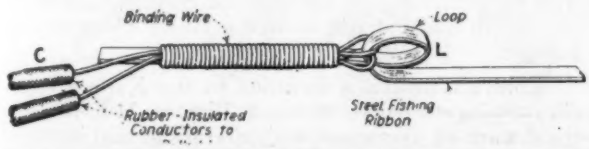



**Fig. 3.—Conductors to Be Pulled In "Made Up" In a Loop In a Fishing Ribbon.**

*If the Conduits Into Which Wires Are to Be Pulled Are Small in Proportion to the Over-all Size of the Wires* to be pulled in, it is advisable to compress the loop in the end of the fishing wire, making it flatter than shown in the illustrations. One bared conductor end is "made up" into this flattened loop. The other bared conductor is served around its bared mate from which the insulation has been trimmed for a distance of about 3 in. This provides the long tapering attachment which, if carefully served with tape, will draw readily into any conduit sufficiently large to receive the wire. While this description treats of but two wires, if there are three the general methods are the same, as will be apparent upon trial.

*(To be continued.)*

## FORMS FOR ELECTRICAL INSPECTION BY MUNICIPAL DEPARTMENT.

### Electrical Ordinance of Manhattan, Kans., Requires Examination of Electricians, as Well as Inspection of Their Work.

Among cities that have recently been added to the steadily lengthening list that require electrical inspection of installations before service can be rendered is the city of Manhattan, Kans. A new ordinance was recently passed by the City Commission which requires that all electricians must pass an examination before work can be done by them on any building. It is planned to have these examinations somewhat similar

CITY OF MANHATTAN
OFFICE OF THE
ELECTRICAL INSPECTOR

NO.....

**APPLICATION FOR WIRING PERMIT**

Manhattan, Kansas.....

I, the undersigned, hereby make application to install the electric wiring and fixtures, apparatus, or appliances listed below in the..... of Mr. ..... at ..... Street, Manhattan, Kansas, as follows.

| FIXTURES, APPLIANCES, APPARATUS, ETC | 1 | CONSTRUCTION | 2 |
|---|---|---|---|
| No. Lights | | | |
| No. Light Outlets | | Armored Cable | |
| No. Switch Outlets | | Metal Conduit | |
| Drops or Fixtures | | Metal Moulding | |
| Motors | | Knob and Tube | |
| Electric Signs | | New Building | |
| Picture Machines | | Old Building | |
| Switch Boards | | Addition to Old Work | |
| Decorative Lighting | | Addition to New Work | |
| Electric Fans | | Alterations | |
| Miscellaneous | | Repairs | |
| NO. OF CIRCUITS | | | |

In column 1 give figures. In column 2 check with X

Remarks .....

All work to be installed in accordance with Ordinance No. 439, and subject to inspection by the Electrical Inspector of the City of Manhattan, Kansas. No construction work to be done until permit for same is issued by the Electrical Inspector.

Approved ..... Signed .....

Rejected ..... Address .....

Permit No .....

**Application Form for Wiring Permit in Manhattan, Kans.**

CITY OF MANHATTAN
OFFICE OF THE
ELECTRICAL INSPECTOR

NO.....

**Electrical Wiring Permit**

Manhattan, Kansas .....

Owner .....

No. ..... Street.

Permit is hereby granted to Mr. ..... a licensed electrician to install the electric wiring, fixtures, appliances, etc. as described in his application, No. ....., and given below, at the above described property.

| FIXTURES, APPLIANCES, APPARATUS, ETC | 1 | CONSTRUCTION | 2 |
|---|---|---|---|
| No. Lights | | | |
| No. Light Outlets | | Armored Cable | |
| No. Switch Outlets | | Metal Conduit | |
| Drops or Fixtures | | Metal Moulding | |
| Motors | | Knob and Tube | |
| Electric Signs | | New Building | |
| Picture Machines | | Old Building | |
| Switch Boards | | Addition to Old Work | |
| Decorative Lighting | | Addition to New Work | |
| Electric Fans | | Alterations | |
| Miscellaneous | | Repairs | |
| NO. OF CIRCUITS | | | |

In column 1 give figures. In column 2 check with X

Remarks .....

All work to be installed in accordance with Ordinance No. 439, and subject to inspection by the Electrical Inspector of the City of Manhattan, Kansas. No construction work to be done until permit for same is issued by the Electrical Inspector. No current to be turned on said wiring, except for testing, until a certificate of approval shall have been obtained from City Electrical Inspector

Arthur J. Rhodes
City Electrical Inspector.

Form of Electrical Wiring Permit.

to those required in that city for plumbers. The plumbing examination consists largely of requiring the applicants to examine charts in which defects in plumbing equipment must be pointed out. Arthur J. Rhodes, city engineer and chief electrical inspector, would be glad to hear from the authorities of other cities, or of states, where electricians' examinations are held as to the procedure used and typical questions propounded. If charts of circuit defects, etc., similar to those referred to above are used, Mr. Rhodes would be pleased to have copies sent him.

CITY OF MANHATTAN
OFFICE OF THE
ELECTRICAL INSPECTOR

NO.....

**CERTIFICATE OF ELECTRICAL INSPECTION**

Date ..... Application No. .....

Owner ..... No. ..... Street

Electrician ..... Permit No. .....

| FIXTURES, APPLIANCES, APPARATUS, ETC | 1 | CONSTRUCTION | 2 |
|---|---|---|---|
| No. Lights | | Armored Cable | |
| No. Light Outlets | | Metal Conduit | |
| No. Switch Outlets | | Metal Moulding | |
| Drops or Fixtures | | Knob and Tube | |
| Motors | | New Building | |
| Electric Signs | | Old Building | |
| Picture Machines | | Addition to Old Work | |
| Switch Boards | | Addition to New Work | |
| Decorative Lighting | | Alterations | |
| Electric Fans | | Repairs | |
| Miscellaneous | | DEFECTS | |
| NO. OF CIRCUITS | | | |

In column 1 give figures. In column 2 check with X

Remarks .....

This certifies that the above described electrical work has been installed and inspected and same is in compliance with City Ordinance No. 439.

**Inspection Fees:**

Electric Wiring .....

Fixtures, Appliances Etc. ..... Total .....

Arthur J. Rhodes
City Electrical Inspector.

Form for Inspection Certificate.

Another feature of the new ordinance of Manhattan is that it establishes regular electrical inspection. An application for a wiring permit must first be filed and if this is approved an electrical wiring permit is issued. The work is inspected both during its progress and at its completion, and if found to agree with the regulations a certificate of electrical inspection is issued. The forms used for these purposes are very simple and for this reason are reproduced herewith as they may give suggestions to other municipalities.

## CODE-CHANGE CORRECTION.

In publishing the list of changes made in the 1918 edition of the National Electrical Code a typographical error was inadvertently overlooked in our issue of Dec. 7, 1918. Referring to Rule 26, Section f, the word accessible should be *inaccessible*. It is in inaccessible roof spaces that wires may be supported by knobs supported directly on the upper edge of each joist. This construction is not allowed, however, where the roof or attic space, although unfinished, is accessible by means of a trap door in the roof or floor, a window or in any other way, since in crawling about in such a space the wires would very likely be kicked or brushed off their supports and thus thrown directly on the joists or brought into contact with each other. This error has been called to our attention by Washington Devereux, president of the National Association of Electrical Inspectors, to whom we were indebted for the entire list of Code changes.

## AMONG THE CONTRACTORS.

The Spilger Electric Co., 78 Warren street, New York City, has been awarded a contract for electrical work in the new Y. M. C. A. building now in course of construction at 181st street and University avenue.

In connection with various improvements being made at the Brooklyn (N. Y.) Navy Yard by the Government, contract for electrical work has been awarded to the E. J. Electric Installation Co., of New York City, at $4668.

Richards Brothers, Lansford, Pa., have been awarded a contract for electric wiring in connection with a new two-story building now in course of construction by Paul V. Irmishek, of Lansford, to cost $10,000.

Contract for electric wiring in the new two-story and basement building being erected on Stockton avenue by George A. and S. R. Kelly, of Pittsburgh, Pa., has been awarded to the Morganstern Electric Co., 325 Second avenue, in that city.

Clarence D. Nuss, North Wales, Pa., has been awarded a contract for the electric work in connection with the rebuilding of the plant of Samuel C. Kriebel, 217 North Main street, located at West Point, to cost $10,000.

Contract has been awarded to the Kahn Electric Co., 505 North Eutaw street, Baltimore, Md., for electrical work in connection with alterations and improvements being made at the club house of the Western Maryland Railroad Co.

# New Appliances

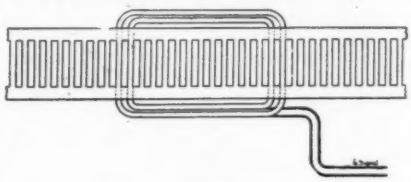
## *Unique Electric System for Industrial Transportation—Decorative Shades for Semi-Indirect Lighting Fixtures*

### Electric Hauling System Contains Many Novel Features.

The system of electrical hauling designed and constructed by the Electric Carrier Co., 220 Broadway, New York, differs radically in many respects from the usual methods of hauling. Although it cannot be recommended as economical in small plants or other places where the quantity of material to be hauled is small or where the routes are subject to change, it has a great many advantages in mines and similar locations in hauling all sorts of material.

The system consists of a source of alternating current, cars running on rails, track and car motor members, and two conducting rails. It can be installed on the surface, underground or elevated. The distinguishing novelty of the system is the method used to propel the cars. Instead of mounting a complete motor upon the car and transmitting mechanical power through gears to the car wheels, the elements of a polyphase induction motor are separated, the primary element being straightened out and carried on the bottom of the car, while the secondary is spread out and extended between the rails on the track. The car is propelled by the magnetic force created between the progressive field of the car element and the induced current in the track element. Both motor members are made of laminated iron. The slots of the car member contain open-circuit wire windings; those of the track member, closed-circuit windings of the squirrel-cage type.

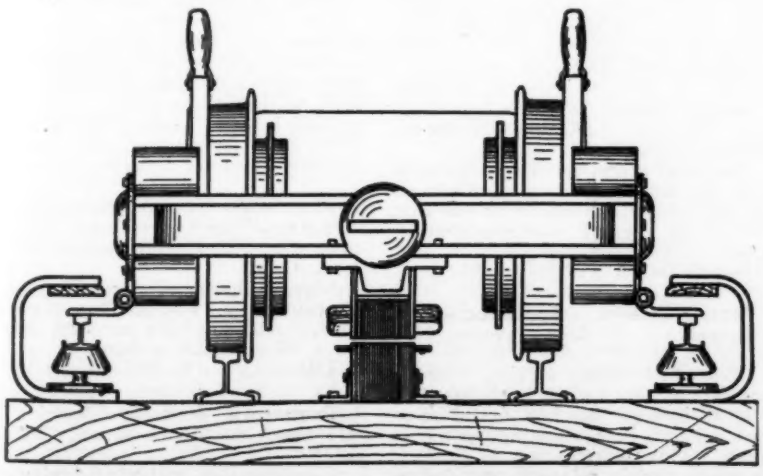
It is claimed that simplicity of the arrangement reduces the cost of operation and maintenance to a minimum. Having no rotary motor nor gearings, no armature nor commutator, the cars require neither oiling nor attendance, and are practically fool-proof. The entire car space is available for freight. Cars can be started, speeded up or slowed down, stopped or reversed, by pressing the buttons which control the current supplied to the two feeder rails, without shock to car or contents. Cars may be switched automatically from the main line to branch lines, or from



Signal System, Showing How Coils Are Wound Under Copper Grid in Track Motor Member.

branch lines to the main line. When descending a grade, power is regenerated back into the line, the conserved energy serving as a brake and also reducing the amount of energy consumed from the power house.

Where a signal system is desired to indicate the location of cars in transit, insulated coils of wire are wound at intervals in the track motor member, and these coils, receiving an induced current as the car passes over them, transmit the signals to the indicating apparatus at either or both terminals. The coils, being impregnated with moisture-repelling compound, are waterproof. As there are no physical contacts, the signal system cannot burn out or get out of order.



End View of Locomotive Car Built by the Electric Carrier Co., Showing Arrangement of Electrical Windings and Equipment.

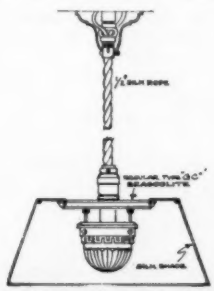
### Decorated Brascolite Fixture.

The Luminous Unit Co., St. Louis, Mo., has added a new and interesting type to its extensive line of Brascolites known as the decorated type. This new line uses one of the well-known commercial types as a basis of its construction and is suspended by a silk cord to form a highly deco-

Decorated Brascolite Fixture.

rative and really efficient unit for residential or other artistic application, such as tea rooms, public dining rooms, candy shops, etc.

The silk shade not only adds a decorative function to the Brascolite fixture, but also by reflected light from the white interior lining elim-



Partial Section, Showing Arrangement of Decorated Unit.

inates entirely any ceiling shadow which might otherwise be present, as well as to diffuse the direct light in such manner as to create a very pleasing lighting effect and at the same time retain the high efficiency always desirable but so seldom obtainable in a decorative lighting fixture.

A choice of color scheme is provided in the standard line as the shade and cord is furnished in old rose, old gold or gray at the option of the purchaser.

# Latest Approved Fittings

*The electrical fittings listed and described in this department have been approved by the Underwriters' Laboratories, Incorporated, after examination and tests conducted under standards of the National Electrical Code as recommended by the National Fire Protection Association.*

**Autostarters.**—Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Quick-break switch and air-cooled transformer mounted as unit in metal case with or without overload and no-voltage release coils. Used as means whereby potential impressed upon alternating-current motor terminals may be made less than full line voltage during starting process.

In off position transformer and motor windings are disconnected from line. Overload release is inoperative during process of starting motor and other circuit-breakers or fuses are necessary in motor circuit. Capacity 50 hp. or less, 600 volts or less. "Type A."

Listed Nov. 18, 1918.

**Cutout Bases, Plug Fuse.**—Barber Electric Manufacturing Co., North Attleboro, Mass.

"Barber," 0-30 amperes, 250 volts. Catalog Nos. 1935, 2165, 2199, 2569, 2965, 8020, 8042.

Listed Sept. 11, 1918.

**Carbonators, Electric.**—The Bastian-Blessing Co., 125 West Austin avenue, Chicago, Ill.

"Knoxall" and "Eclipse" models. Carbonator driven by enclosed motor controlled by automatic switch actuated by weight of water in tank. Designed for use in carbonating water. ⅛ hp., 110-220 volts, alternating or direct current.

Listed Nov. 6, 1918.

**Flexible Tubing.**—Toronto Conduits & Cables, Ltd., 331-33 King street, West, Toronto, Ont., Canada.

Marking: Knitted fabric having one yellow thread.

Listed Oct. 2, 1918.

**Flexible Tubing Fasteners.**—K-B Manufacturing Co., 287 Second street, San Francisco, Cal.

"K-B." For securing flexible tubing in outlets.

Listed Nov. 26, 1918.

**Fixtures.**—Collins-Wagner Manufacturing Co., 244 West 29th street, New York, N. Y.

Listed Oct. 15, 1918.

**Fixtures, Show-Window and Show-Case Type.**—Frederick A. Watkins, 565 West Washington street, Chicago, Ill.

"R-2-I."

Listed July 19, 1918.

**Fuses, Cartridge.**—Elliott Electric Co., 517 Spring street, Shreveport, La.

"Service" cartridge enclosed fuses. 0-60 amperes, 250 volts.

Listed Oct. 18, 1918.

**Fuses, Plug.**—Merrill Manufacturing Co., 294 Washington street, Boston, Mass.

"Merrill" Edison plug fuses, 0-30 amperes, 125 volts.

Listed Aug. 20, 1918.

**Heaters—Electric Ranges.**—Rathbone-Sard Electric Co., Albany, N. Y.

"Acorn" electric ranges. 110-220 volts, 5400-7000 watts, Types E-15, E-25, E-40, E-70, for use in two or three-wire circuits. 110-220 volts, 8500-12,000 watts, Types E-35, E-45, E-50, E-55, E-60, E-65, for use on three-wire circuits only.

Listed May 15, 1918.

**Heating Appliances, Cooking and Liquid.**—Duparquet, Huot & Moneuse Co., 108-114 West 22nd street, New York, N. Y.

Electrically heated cooking appliances for voltages up to 250.

Broilers, 5000-9000 watts, Types B, HB, SB.

Hot plate, 2000 watts, Type HP-2.

Kettle, 1500-12,000 watts, Type K.

Ranges, 7000-22,000 watts, Type R.

Steam table, 3000-6000 watts, Type ST.

Urns, 1000-6000 watts, Types U, CU, WU.

Listed Oct. 11, 1918.

**Heating Appliances, Industrial and Laboratory.**—American Ironing Machine Co., 166-8 North Michigan avenue, Chicago, Ill.

"Simplex" ironing machines having fixed iron-clad enamel-insulated heaters and motor-driven padded rolls, in sizes up to 56 in. in length. Two-wire, 110 and 220 volts, and three-wire, 110-220 volts, 20 to 70 amp.

Listed Nov. 15, 1918.

**Horns, Siren.**—Federal Sign System (Electric), Lake and Desplaines streets, Chicago, Ill.

"Federal" siren horns, 250 volts or less, alternating current and direct current. Type A, interior or exterior, 1 to 10 hp. Type B, single or double-head, 1½ to 5 hp.

Listed Oct. 11, 1918.

**Motion-Picture Appliance.**—The Seligraph Co., 92 Lenox avenue, New York, N. Y.

"Film Fire Safety Device." Device consists of pilot switch held closed by fuse so located that film fire at aperture ignites, fuse allowing switch to open. This interruption of current in pilot circuit releases two knives which cut film at magazine and switch which controls lamps, motor, auditorium and orchestra signal circuits.

Examinations and tests indicate that when properly installed this device affords a certain degree of protection against hazards incident to ignition of film at aperture of a projecting machine.

It does not give protection against hazards from other films which may be in booth, nor is it equivalent of or substitute for booth itself.

Listed Nov. 29, 1918.

**Motion-Picture Appliance—Lamp Regulator.**—General Electric Co., Schenectady, N. Y.

Consisting of adjustable reactance and single-pole switch in series with primary of auto-transformer, secondary of which is in series with ammeter and lamp controlled. Enclosed in sheet-metal cabinet and designed for controlling incandescent lamps in which it is desirable that current value should be kept constant. Primary 7.2 amperes, 100-125 volts; secondary 20 amperes, 28-30 volts.

Listed Sept. 5, 1918.

**Outlet Bushing and Fitting.**—The Gillette-Vibber Co., 32 Maple avenue, New London, Conn.

Two-piece, galvanized, cast-iron terminal fittings with composition covers with wire openings for capping ends of rigid conduit. Catalog Nos. 10002, 10003, 10112, 10114, 10212.

Only for inside work, and only when secured to threaded ends of conduit with standard locknuts.

Listed Aug. 3, 1918.

**Outlet Bushings, Service-Entrance.**—Multi Electrical Manufacturing Co., 703 Fulton street, Chicago, Ill.

"Multi" bushings of cast iron, threaded for connection to rigid conduit and having porcelain plate with holes for conductors. Type F.

Listed Oct. 14, 1918.

**Outlet Bushings, Service-Entrance.**—The Gillette-Vibber Co., 32 Maple avenue, New London, Conn.

"Gee-Vee" cast-iron outlet bushings. Catalog Nos. 6001, 6002, 6003, 6112, 6114, 6212.

"G-V Universal," Catalog Nos. 3004, 3312.

Listed Aug. 2, 1918.

**Picture-Machine Appliance—Lamp Adapter.**—The Argus Lamp & Appliance Co., 322 Euclid avenue, Cleveland, Ohio.

"Argus-Sheck Universal" incandescent lamp adapter for arc-lamp house. Designed for use with 20-ampere, 30-volt Mazda lamps.

Listed Oct. 11, 1918.

**Protectors.**—Reliable Electric Co., 411 South Sangamon street, Chicago, Ill.

Consisting of carbon lightning arresters with enclosed cartridge fuses

for use on signal circuits. Enclosed in porcelain case with flanged cast-iron cover and rubber gasket. Catalog Nos. 997-A, 997-B.
Listed Aug. 6, 1918.

**Receptacle, Mogul-Base.** — The Luminous Unit Co., 2615 Washington avenue, St. Louis, Mo.
"L. U. Co." porcelain shell.
Keyless, Catalog No. 101.
Listed Aug. 6, 1918.

**Receptacles for Attachment Plugs.**—Ajax Electric Specialty Co., 1011 Market street, St. Louis, Mo.
Flush Edison screw-shell type, 660 watts, 250 volts, Catalog No. 578.
Listed Oct. 3, 1918.

**Receptacles for Attachment Plugs, and Plugs-Marine.**—Benjamin Electric Manufacturing Co., 120-28 South Sangamon street, Chicago.
"Benjamin." 660 watts, 250 volts.
Receptacles, catalog Nos. 6968, 6969, 6980, 6981, 6984 and 6985.
Plugs, catalog Nos. 6762 to 67 inclusive.
Receptacles complete with box, cover and gasket, catalog Nos. 6712 to 21 inclusive, 6740 and 6741.
Listed Nov. 22, 1918.

**Receptacle, Medium-Base.**—Adapti Manufacturing Co., Cleveland, Ohio.
"Adapti," porcelain shell, catalog No. 564-B, with bases 4120-B and 4127-B.
Listed July 22, 1918.

**Switches, Automatic, Pressure-Operated Type.**—Brunner Manufacturing Co., Utica, N. Y.
Automatic switch consisting of brush contact switch operated by springs and levers actuated by pressure variation on diaphragm within chamber attached to switch base; designed to automatically control apparatus for maintaining desired air pressure. 10 amperes, 250 volts, 20 amperes, 125 volts. Model M.
Listed Oct. 31, 1918.

**Sockets, Mogul Base.**—The Bryant Electric Co., Bridgeport, Conn.
"Bryant" or "Perkins" porcelain shell.
Keyless, 1500 watts, 600 volts, Catalog No. 4089-Special.
Listed Aug. 6, 1918.

**Switch Boxes.**—The Potter-Acme Manufacturing Co., 1060 Superior avenue, N. W., Cleveland, Ohio.
"Potter" sheet-steel, single and gang type boxes for mounting switches and receptacles.
Flexible-tubing pattern, Catalog Nos. 71, 72.
Rigid and flexible-conduit patters Catalog Nos. 80, 83, 84.
Listed July 27, 1918.

**Switches, Automatic, Pressure-Operated Type.** — The Blackburn-Smith Corporation, 105 West 40th street, New York, N. Y.
"Blackburn-Smith" enclosed single-pole switch operated by float actuated by variation of liquid level in a tank. Designed to control current to direct-current or alternating-current solenoids, 5 amperes, 250 volts.
Listed Aug. 23, 1918.

**Sign Flasher.**—Automatic Electric Controller Co., Inc., New Nester building, Seattle, Wash.
Electromagnetic sign flasher of solenoid-operated switch type. Model 144, alternating current, 110 volts, 3000 watts.
Listed Oct. 11, 1918.

**Signal Appliances, Miscellaneous.**—The Autocall Co., Shelby, Ohio.
"Autocall" relays for use in signaling circuits, 110-250 volts.
Type A, breaking capacity 5 amp.
Type G1, single-pole, breaking capacity 25 amp.
Type G2, double-pole, breaking capacity 25 amp.
Listed Nov. 19, 1918.

**Signal Appliances, Miscellaneous.**—Benjamin Electric Manufacturing Co., Chicago, Ill.
"Benjamin" Telecode relay for use on signaling circuits, such as telephones, for sounding extension bells or horns supplied from lighting circuits. 0.35 amp., 125 volts.
Listed Aug. 9, 1918.

**Signs.**—Federal Sign System (Electric), 1737 Telegraph avenue, Oakland, Cal.
Electrically illuminated display signs for general use.
Listed Nov. 20, 1918.

**Switches, Enclosed.**—California Electrical Construction Co., 641 Mission street, San Francisco, Cal.
"Ceco." Standard fused switch mounted in sheet-metal cutout box and provided with handle for manual operation without opening case. All standard current ratings, 250 volts.
Listed Nov. 19, 1918.

**Switches, Oil-Break.** — Electrical Machinery Co., 524 California street, Sacramento, Cal.
"Van Alstyne." Two or three-pole, oil-immersed switches designed for manual operation without opening case, provided with no-voltage release coils and in sizes up to and including 440 volts or less, 100 amp. or less.
Listed Sept. 13, 1918.

**Switches, Push Flush.**—The Standard Electric Manufacturing Co., 216 North Clinton street, Chicago, Ill.
Single-pole, catalog No. 5001.
Double-pole, catalog No. 5002.
Three-way, catalog No. 5003.
Listed Sept. 28, 1918.

**Switches, Push and Rotary Flush, Marine.**—Benjamin Electric Manufacturing Co., 120 South Sangamon street, Chicago, Ill.
"Benjamin." Single-pole, Catalog Nos. 6955, 6998-69 inclusive.
Double-pole, Catalog No. 6954.
Watertight box complete with single-pole switch, Catalog Nos. 6728, 6729, 6754-59 inclusive, 6974-77 inclusive, 8432, 8493-99 inclusive, 8500, 8504, 8526-29 inclusive, 8568, 8569, 8591-94 inclusive, 8603, 8604, 8663, 8664.
Watertight box complete with double-pole switch, Catalog Nos. 6710, 6711, 6746, 6747.
Non-watertight box complete with single-pole switch, Catalog Nos. 6748, 6749, 6788, 6789, 6792-99 inclusive, 8413, 8465, 8599, 8600-02 inclusive.
Non-watertight box complete with double-pole switch, Catalog Nos. 6770, 6771.
Listed Nov. 22, 1918.

**Transformers, Bell-Ringing.**—Julius Becker, 438 Briar place, Chicago, Ill.
Air-cooled transformer designed to supply current at low voltage. For use only in ringing bells or for similar signaling work when primary wiring is installed in accordance with Class C rules, National Electrical Code.
"Becker," 60 cycles, primary 110 volts, secondary 8 volts.
Listed July 25, 1918.

**Welding Machines.**—The Taylor Welder Co., Warren, Ohio.
"Taylor" electric welding machines, 7-25 kv-a., 110, 220, 440 or 550 volts. Types D-6-1 to D-48-4 inclusive.
To be installed in manner and location acceptable to inspection department having jurisdiction, and with suitable ground connection.
Listed Dec. 20, 1918.

**Wires, Slow-Burning.**—Alfred F. Moore, 200-18 North Third street, Philadelphia, Pa.
Fixture wires, stranded conductors, furnished as single conductor of twisted pair. For use in fixtures within buildings, including fixtures for gas-filled incandescent lamps.
Nos. 18 and 16 B. & S. gauge. Two types: First covered with cotton wrap and cotton braid impregnated with slow-burning compound and either slicked down or finished with outer silk or cotton braid; second covered with cotton wrap and two asbestos wraps impregnated with slow-burning compound and finished with outer silk or cotton braid.
No. 14 B. & S. gauge with cotton wrap, two impregnated cotton braids and finished with outer silk braid.
Marking: Red, white and blue cotton threads cabled with copper strands.
Tag on coil to read: "National Electrical Code Standard."
Listed Aug. 6, 1918.

**Wires, Slow-Burning.** — Independent Lamp & Wire Co., 1747 Broadway, New York, N. Y.
"Salamander." Heater cords. Flexible conductor, Nos. 12 to 18 B. & S. gauge inclusive, with compound felted asbestos insulation; twisted to a double conductor, compounded asbestos braid or cotton braid, or both, over all.
Motion-picture-machine cable. Flex-Solid conductor, Nos. 4 to 18 B. & S. guage inclusive, compounded felted asbestos insulation and compounded asbestos braid.
Switchboard and controller wire. Solid conductor, Nos. 4 to 18 B. &S. gauge inclusive, compounded felted asbestos insulation and compounded asbestos braid.
Stove and furnace wire. Solid conductor, Nos. 1 to 16 B. & S. gauge inclusive, compounded felted asbestos insulation and compounded asbestos braid.
Marking: Flexible conductors—White cotton thread cabled with copper strands. Solid conductors—White cotton thread running parallel with conductor.
Listed Aug. 9, 1918.

# Trade Activities

## F. W. Rust & Co. Organized—Robbins & Myers Changes Managers—Literature Distributed by the Manufacturers

**Walter A. Zelnicker Supply Co.,** 325 Locust street, St. Louis, Mo., recently issued Bulletin No. 250, which lists both new and second-hand equipment, including power plant equipment, machine tools, hoists, contractors' equipment, etc.

**Randle Machinery Co.,** Cincinnati, Ohio, recently issued an eight-page booklet, giving a partial list of its line of power plant equipment including engines, boilers, motors, generators, machine tools and supplies. Brief and comprehensive data concerning each item is given and many bargains in power plant equipment are offered.

**Cincinnati Specialty Manufacturing Co.,** Inc., Cincinnati, Ohio, has just issued a circular descriptive of the automatic extension reel for electric lamps. The reel is a very simple device designed for use in factories, machine shops, garages, in fact, for use in any place where extension lamp is required. It is also extensively used for portable electric drills, grinders, fans, etc. The reel is nine inches in diameter and is equipped with 25 ft. of reinforced cord. The head is provided with a swivel joint, enabling the lamp to be carried in any direction from the reel and an automatic lock. This device has been examined, tested and listed as standard by the Underwriters' Laboratories.

**Fuller Engineering Co.,** designing and constructing engineer, Allentown, Pa., announces that Frederick A. Scheffler, formerly connected with the New York offices of the Babcock & Wilcox Co., has now become associated with the company and will make his headquarters at its New York office, 50 Church street, Hudson Terminal, New York City. The Fuller Engineering Co. is making a specialty of applying the pulverized coal method of firing to boilers of all kinds for generating power. Mr. Scheffler will be in a position to furnish complete information regarding the cost of installation, preparation and probable economies obtainable by the adoption of this method of firing coal.

**Robbins & Myers Co.,** Springfield, Ohio, announces the following changes in its branch managers: I. Elkas, who for a number of years has been manager of the St. Louis branch office of the company, has been transferred to Chicago, where he succeeds R. R. Caskey, resigned. J. F. Galvin, formerly assistant to Mr. Elkas at St. Louis, will succeed him as manager of the St. Louis office. Guy H. Gibbs, who has been in charge of the Cincinnati office since R. C. Decker went into Government service, has been transferred to the export department and will assist Mr. Wilhelmi. Mr. Gibbs was in charge of the R. & M. exhibit at the San Diego exposition and later assisted at the Chicago office. It is possible that he may serve later as European representative for the company.

**General Lead Batteries Co.,** with main offices at Newark, N. J., has published bulletin No. 28 entitled, "The Theory of the Storage Battery." This is a very carefully prepared condensed treatise on the chemical and electrical theory of the lead storage battery. It describes not only the reversible process but also the method of forming and constructing lead cells, the advantage of Plante and pasted types, difficulties developed in former practice, such as sulphation, how this can be overcome and made of actual service and finally a brief description is given of Titan pasted plates manufactured by this company. This booklet should be in the hands of everyone interested in knowing exactly what takes place in a storage battery.

**Railway & Industrial Engineering Co.,** Pittsburgh, Pa., has issued a well illustrated folder on "Outdoor Transformer Substations," and the application of the Burke switch and horn-gap lightning arresters thereto. Over 10 substations are illustrated in which this equipment is used. These are substations serving electrical central-station systems and numerous important industrial and coal-mining companies. A number of views are shown of the Burke horn-gap switch and also the new vertical break switch and the horn-gap lightning arresters. The company shows how its facilities have enabled it to design and build all of the switching and protective equipment as well as the supporting steel work for outdoor substations of moderate to extremely high voltages and of various sizes.

**Deister Concentrator Co.,** with main office, factory and test plant at Fort Wayne, Ind., has issued a valuable bulletin, dealing with the No. 7 Deister-Overstrom diagonal deck coal washing table. It discusses the development of processes in the washing of bituminous coal for the reduction of non-combustibles, and points out how a high percentage of combustible is recovered by the use of the table. Tremendous advantages are claimed for this coal washing table, among which the following are enumerated as the principal ones: It removes objectionable sulphur, which is very important from even a physical standpoint, as fires from spontaneous combustion in coal bins and coal piles are largely due to the heat generated in coal containing a considerable amount of sulphur; reduces loss of combustible in ash; increases heating value, increases boiler efficiency; decreases transportation difficulties and makes marketable product from low-grade coal, or screenings, heretofore wasted. Numerous flow sheets of suggested arrangements, both for general washing of coal and for use in connection with pulverizing plants, are included in the bulletin. A foundation and general drawing print of the No. 7 Deister-Overstrom diagonal deck coal washing table is also shown.

**F. W. Rust,** formerly interested in the Rainier Electric Co., Seattle, Wash., has organized the firm of F. W. Rust & Co., Inc., and established offices in Seattle National Bank building. The new concern gives special attention to lighting and power installations in industrial plants, and has adopted the plan of taking contracts on a cost-plus-percentage basis.

**Automatic Light Co., Inc.,** McKnight building, Minneapolis, Minn., has prepared a convenient folder on its Alco farm lighting and power plants. The history of the development of the Alco plant is given, and views of different types and parts thereof are shown. The principal Alco plant made is an automatic 110-volt equipment which is capable of furnishing not only light but also power on the premises. It requires only a very small storage battery for starting purposes. The company also makes a 32-volt battery plant for places where this type of equipment is insisted on. Typical installations are shown and suggestions for dealers in demonstrating the equipment.

**Gifford-Wood Co.,** Hudson, N. Y., has now in print and will soon have ready for distribution its general catalog No. 18. The compilation of this edition was made necessary through the demand by engineers and progressive industrial managers for a complete reference book on elevating and conveying machinery and general engineering data. The 480 pages comprising this publication show the application of labor-saving handling methods for various industries, and include data as to dimensions, capacities, and power requirements which will be very helpful to engineers and plant managers in the selection of suitable equipment to meet their conditions. Illustrations of actual installations cover practically every handling problem, and a careful study by owners and managers will undoubtedly suggest a cost saving solution to their particular problems. Various types of elevators and conveyors are illustrated with perspective drawings, the essential points of each type of machine being carefully explained. The details of machinery parts are fully illustrated and tables of dimensions and prices given.

# Current News

## *Weekly Record of Construction Activities—Conventions*

### EASTERN STATES.

**Rutland, Vt.**—Old English Slate Co. is planning to increase operations at its plant. The company has contracted for the furnishing of additional electric power in the amount of 25 hp. The Western Vermont Power & Light Co. is the contractor.

**Rutland, Vt.**—Rutland Railroad Co. has contracted with the Rutland Railway Light & Power Co. for additional electric energy for works operation. Contracts have also been entered into with the Wallingford Manufacturing Co. and the American Fork & Hoe Co. for furnishing increased power for operation.

**Springfield, Vt.**—John T. Slack Corporation has commenced the construction of a new boiler plant at its works.

**Albany, N. Y.**—Fire, on Dec. 1, destroyed three shop buildings of the foundry department of Rathbone, Sard & Co., North Albany, manufacturer of electrical specialties, ranges, etc., with total loss estimated at about $75,000.

**Brooklyn, N. Y.**—A. Arnesen, Inc., operating a general electrical contracting establishment at 312 Court street, has filed notice of an increase in its capital from $10,000 to $50,000, to provide for expansion.

**Brooklyn, N. Y.**—In connection with the proposed merger of the Kings County Electric Light & Power Co. with the Brooklyn Edison Co., plans for which were approved at a recent special meeting of stockholders, it is understood that a protest against the merger will be filed with the Public Service Commission by the city, holding that it is merely an attempt to validate the franchise of the companies alleged to have no legal standing at the present time. The companies have also requested permission to issue bonds for $6,000,000.

**Cohoes, N. Y.**—The Board of Contract and Supply has taken bids for the erection of a new pumping station and filtration plant at the local waterworks, and the installation of new pumping equipment. Eugene M. Herbert, secretary.

**New York, N. Y.**—The Board of Trustees of Allied and Bellevue Hospitals has awarded a contract to L. Gottlieb, 225 East 138th street, for alterations and improvements in the powerhouse at the hospital building at Lenox avenue and 136th street, including the installation of new ash handling equipment. Dr. John W. Brannan is president.

**New York, N. Y.**—The Broadway Association is said to be taking initial steps for the installation of a new and improved electric street-lighting system on Broadway from the Battery to Columbus Circle. It is understood that the proposed plans include the installation of a four-light cluster on each corner and one in the center of each block in this district. Major Henry G. Opdyke is managing director of the association.

**Sayville, L. I., N. Y.**—The Government, Bureau of Yards and Docks, has awarded a contract to the Hennebique Construction Co., 1170 Broadway, New York, for the construction of a transformer building and other work at the local Government station.

**Waterville, N. Y.**—Waterville Gas & Electric Co. filed with the upstate Public Service Commission a petition for approval of the exercise of a franchise granted to construct and operate an electric system in that town. Period residents have asked the company to give them an electric lighting service.

**Atlantic City, N. J.**—The Board of Freeholders has made an appropriation of $6,000 in its annual budget for 1919, to be used for the lighting of county roads.

**Bernardsville, N. J.**—The Board of Education has recently completed the installation of new motors and other equipment at the local high school for the operation of the ventilation system, etc. Electric energy will be supplied by the New Jersey Power & Light Co., Dover.

**Camden, N. J.**—In connection with the annual budget for 1919 arranged by the city officials, the sums of $105,000 and $13,500 have been requisitioned to provide for lighting purposes and the operation of the Electrical Bureau, respectively.

**Hackettstown, N. J.**—Hackettstown Electric Light Co. has made application to the Board of Public Utility Commissioners for permission to increase its rates for service. The plan includes increased rates for metered lighting service of three cents gross and two cents net per kw-h., with a minimum monthly charge of $1.15 as compared with the present rate of $1.00.

**Jersey City, N. J.**—The Boulevard Commission has taken bids for the installation of the proposed new electric street-lighting system on the boulevard, between the Morris Canal and Manhattan avenue. Walter J. Coleman, 29 Willow court, Jersey City, submitted the low bid of $9,400. It is proposed by the Commission to install new lamps of increased candlepower in various other sections of the boulevard at an early date.

**Jersey City, N. J.**—Electric Lamp Products Co., 512 Paterson Plank road, has filed notice of an increase in its capital from $40,000 to $60,000, to provide for general expansion.

**Newark, N. J.**—Hercules Electric Motor Corporation, 283 Mt. Pleasant avenue, has filed a petition in bankruptcy.

**Plainfield, N. J.**—Operations have been inaugurated at the new power plant recently constructed at the Muhlenberg Hospital at a cost of $10,000. The plant furnishes light, heat and power for the entire institution.

**Sandy Hook, N. J.**—The United States Government has awarded a contract to M. H. Rothschilds, Inc., 244 West 98th street, New York, for the construction of a radio compass station at the local Government site.

**West New York, N. J.**—Hudson County Board of Freeholders has completed plans for the construction of a one-story power house heating and lighting plant, about 97x187 ft., at the county institution at Laurel Hill. The structure will be reinforced concrete and brick. Oscar L. Auf der Heide, Court House, Jersey City, is chairman of the board.

**Honesdale, Pa.**—The $30,000 electric light plant of the Consolidated Heat, Light & Power Co. was damaged by fire. Loss $30,000; insurance, $24,000. The company will rebuild the plant.

**Harrisburg, Pa.**—The city is planning for improvements in the electric street-lighting system during the present year, including the installation of new arc lighting units, new lighting standards, and extensions in the system in the Fourteenth ward.

**Philadelphia, Pa.**—Electric Furnace Construction Co., Finance building, has filed notice of an increase in its capital from $100,000 to $300,000 for expansion.

**Philadelphia, Pa.** — Philadelphia Rapid Transit Co. has completed arrangements for the erection of the proposed addition to its substation at Frankford avenue and Arrott street. The structure is estimated to cost $12,000.

**Philadelphia, Pa.**—George Sachsenmaier & Co., 145 North Third street, manufacturers of dynamos, etc., have had plans prepared for the construction of a one-story shop and office building at 926 North Third street. Le Roy B. Rothschild, 1225 Sansom street, is architect.

**Philadelphia, Pa.**—Frank H. Stewart Electric Co., 37 North Seventh street, has submitted the low bid to the city for the construction of the proposed power plant, fire and police station at 24th and Rittner streets at $304,245.

**Philadelphia, Pa.**—The Government, Navy Department, has arranged for the installation of five new boilers at the League Island Navy Yards. The Department will also

install two new boilers at the navy yard at Washington, D. C. Contracts for the settings have been awarded to Albert Doak, 2138 Arch street, at $24,000.

**Reading Pa.**—Carpenter Steel Co. has awarded final contracts for the erection of the proposed one-story brick, concrete and steel power plant to be located at River road and Exeter street, estimated to cost $110,000. The Beard Construction Co., 658 Penn street, Reading, is in charge of building operations.

**Rutherford, Pa.**—Philadelphia & Reading Railroad Co., Reading Terminal, Philadelphia, has completed foundation for the construction of the proposed local one-story compressor building, about 26x63 ft. in size, to cost $10,000.

**Sparrows Point, Md.**—Bethlehem Steel Co. is making rapid progress in the construction of the proposed additions to its local shipbuilding plant. A new fabricating shop, about 40x160 ft., will be erected, a new electrical shop, about 75x150 ft. in size, and auxiliary structures.

**St. Helena, Md.**—Dundalk Co. has had plans prepared for the erection of a new pumping station, including the construction of three buildings, estimated to cost $25,000. E. L. Palmer, 523 North Howard street, Baltimore, is architect.

**Washington, D. C.**—Washington Railway & Electric Co., 14th and East Capitol streets, has awarded a contract for the erection of a one-story concrete electric substation.

**Bristol, Va.**—Fire, which caused a damage of about $1,500,000, recently destroyed the plant of the Bristol Gas & Electric Co.

**Anderson, S. C.**—Anderson Cold Storage Co. is planning for the establishment of a new ice manufacturing plant to cost about $100,000, to be fully equipped throughout for electric operation. A. S. Farmer and J. Townes Holleman head the company.

**Bunnell, Fla.**—The city will vote on $15,000 bonds to construct waterworks system, electric light plant and pave sidewalks. Address mayor.

**Sarasota, Fla.**—The city has approved the issuance of bonds for $80,000 for the purchase and improvement of the plant of the Sarasota Ice & Electric Co. Paul Thompson is city clerk.

## NORTH CENTRAL STATES.

**Ashtabula, Ohio**—The city is to take up at once the enlargement of the municipal lighting plant. The present plan is to practically double the capacity of the plant. To do this it will be necessary to install another 1,000-hp. boiler as well as some minor equipment. It will not be necessary to enlarge the present building or to build new buildings since the present structure will permit of considerable expansion inside.

**Lima, Ohio**—The city may soon take steps to install a municipal electric light plant. The city has $56,808.95 of a bond issue, voted 10 years ago to build a municipal plant, available for this purpose. It is estimated that by connecting the plant with the city waterworks, where two large generators are already in use, the manufacture of current could be made possible by the expenditure of $100,000. The city council is expected to take action on this matter soon.

### DATES AHEAD.

American Institute of Consulting Engineers, Inc. Annual meeting, New York City, Jan. 18. Deputy secretary, B. Etchelle, 35 Nassau street, New York City.

Northern White Cedar Association. Annual meeting, Hotel Radisson, Wis., Minneapolis, Minn., Jan. 21 and 22. Secretary, N. E. Boucher, 702 Lumber Exchange, Minneapolis, Minn.

Pennsylvania State Association of Electrical Contractors and Dealers. Next meeting, Hotel Adelphia, Philadelphia, Jan. 28. Secretary-treasurer, M. G. Sellers, 1518 Sansom street, Philadelphia.

Western Association of Electrical Inspectors. Annual meeting, Chicago, Ill., Jan. 28-30. Secretary, W. S. Boyd, 175 West Jackson boulevard, Chicago, Ill.

Oklahoma Utilities Association. Annual meeting, Oklahoma City, Okla., Feb. 13, 14 and 15. Secretary, H. A. Lane, Oklahoma, Okla.

Illinois State Association of Electrical Contractors and Dealers. Annual convention, Chicago, Feb. 14 and 15. State secretary, G. A. Engelken, 55 West Harrison street, Chicago.

New Mexico Electrical Association. Annual meeting, Albuquerque, N. Mex., Feb. 17-19. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. Mex.

Wisconsin State Association of Electrical Contractors and Dealers. Annual convention, Hotel Pfister, Milwaukee, Wis., March 24-28. State secretary, John A. Piepkorn, 108 Sycamore street, Milwaukee, Wis.

**New Philadelphia, Ohio** — New Philadelphia will probably have a municipally owned light plant. Acting on the recommendation of Councilman Elexander, the council will consider the franchise of the Ohio Service Co., with an object of discovering some provision that will enable the city to obtain better light.

**Boswell, Ind.**—Farmers' & Merchants' Co-operative Telephone Co. has increased its capital from $12,000 to $50,000.

**Chicago, Ill.**—Ordinances are before the council providing for lights at 120th and Morgan streets, and on Calumet avenue, between 76th and 79th streets. Also for street car extension under I. C. R. R. to Cottage Grove avenue; improved service between 63rd and 119th streets; rerouting 93rd and 95th street time to run south on Michigan avenue to 119th street, filling depressions on 105th street between Corlis and Cottage Grove avenues.

**Peoria, Ill.**—American Milling Co. was damaged by fire, Jan. 1. The mill, dairy barns, power plant and an addition newly built to the plant were destroyed. The loss is estimated at $600,000.

**Quincy, Ill.**—A committee has been appointed to look after the matter of establishing a municipal light plant. Address Mayor Thompson.

**Rockford, Ill.**—The operation of one-man cars in Rockford is absolutely necessary to keep the city railway property out of the hands of a receivership, according to W. C. Sparks, manager of the Rockford City Traction Co.

**Springfield, Ill.**—The Board of Local Improvements will install an ornamental lighting system in the downtown district. Address clerk of the board.

**Rugg (R. F. D. Rapid City), Mich.**—Kalkaska Light & Power Co. will install additional machinery. C. W. Goddard, superintendent.

**Ashland, Wis.**—The construction of a $2,000,000 dam near Ladysmith by the Ashland Power Co. may begin within a few weeks, the plans being nearly completed. The Ashland company, under the control of A. E. Appleyard, obtained control of the water power sites near Mellen on the Montreal river where it empties into Lake Superior.

**Janesville, Wis.**—Consulting Engineer J. C. Jacobson, First National-Soo Line building, Minneapolis, is making the plans for extensions to the municipal hydroelectric generating plant and auxiliary steam generating plant. C. V. Kerch, city engineer.

**Oconto Falls, Wis.**—Frank F. Becker and C. H. Hartley contemplate building hydroelectric power plant and dam between Oconto Falls and Gillett; 2500 to 3000 hp., earth wing walls. Engineers, Mead & Seastone, Madison.

**Prairie Du Chien, Wis.**—Mid-Continental Utilities has applied to the city council for franchise to construct transmission line from city limits to power plant; wooden poles. Chas. Grelle, president.

**Wausau, Wis.**—Plans are completed for power dam. Wisconsin Valley Electric Co., owner. Address M. C. Ewing, manager of the Wisconsin Valley Electric Co., Wausau.

**West Allis, Wis.**—The city of West Allis may build its own lighting plant. Mayor F. S. Baldwin will appoint a committee to investigate facts and figures for a municipal plant. The present contract with the street car company expires next fall. It is claimed the cost of electricity to the consumer could be materially reduced if a municipal plant were maintained.

**Aldrich, Minn.**—Little Falls Power Co will extend its lines into Aldrich and supply the village with lights and power.

**Littlefork, Minn.**—Littlefork Light & Power Co., Inc., has incorporated with a capital of $10,000 to manufacture and sell light and power for commercial purposes. Ernest E. Polkinghorne, incorporator.

**Ortonville, Minn.**—A $75,000 electric plant is to be installed at Ortonville. Address city clerk.

**Pipestone, Minn.**—Pipestone has voted to issue $100,000 of bonds for the improvements of its city water system. Electric pumping apparatus will replace the steam equipment and energy for operation will be furnished by the Southwestern division of the Northern States Power Co. The city of Montevideo, Minn., is adding a 50-hp. motor at the waterworks to supply increased demands. This sta-

tion is operated electrically with power furnished by the Southwestern division of Northern States Power Co.

**Tyler, Minn.**—The citizens will vote on the question of issuing $20,000 in bonds to rebuild light and water system destroyed by fire last summer.

**Wells, Minn.**—The collapse of the city water tower has rendered useless the city light, power and water facilities. The tank fell 75 ft. and crushed the light and power plant.

**Aurora, Mo.**—The installation of a new lighting system is contemplated by several of the prominent business men.

**Concordia, Mo.**—St. Paul's College has had plans prepared for the erection of a new power house at the institution.

**St. Louis, Mo.**—Union Electric Light & Power Co., Twelfth and Locust streets, is arranging for the construction of a boiler plant to cost about $15,000.

**St. Charles, Mo.**—The committee on Waterworks and Fire Protection has recommended that the city buy at once a new four-million gallon high duty pump and that the waterworks get plans ready at once to submit to the council.

**Downs, Kans.**—A $40,000 bond issue has been voted for the construction of a complete electric light plant. Plans will be started at once by W. B. Rollins & Co., engineers, 209 Railway Exchange, Kansas City, Mo.

**Havana, Kans.**—E. W. Worthen, cashier of the Havana State Bank, has been appointed trustee for the Havana Light & Power Co., which has gone into bankruptcy.

**Kansas City, Kans.**—The city commissioners have made an allowance in the annual budget of $2500 for lights.

**Beatrice, Neb.**—The city of Wymore has contracted with the Nebraska Gas & Electric Co. to furnish electric current for a term of five years at a price of 3¼ cents per kw. for the first 10,000 kw., a decrease in price to be made for additional current.

**Miller, S. Dak.**—Much progress has been made in the installation of a new municipal electric light plant, and it is expected it will be completed and in operation in about six weeks.

## SOUTH CENTRAL STATES.

**Benton, Ark.**—The city commissioners are considering plans for improvements and alterations in the local electric light system.

**New Orleans, La.**—An injunction to restrain the New Orleans Railway & Light Co. from collecting a one-cent advance in fare and a 30% increase in the price of gas and electrical current is asked in a suit filed in the civil district court here Dec. 23. The suit has been set for hearing Jan. 6.

**Sapulpa, Okla.**—The Schram glass plant is adding a new motor and compressor to its power installation which will add 100 hp. to the business served by the Sapulpa Electric Co. at this plant.

**Dallas, Tex.**—It is stated by Richard Meriweather, manager of the Dallas Street Railway Co., that nearly $1,000,000 will be expended in improvements to that property during the current year. These improvements are to consist largely in extensions of the different lines. All of the extensions that were approved by the City Commission and which were held up pending the war will now be carried out, he said. Material for the proposed work will be assembled as rapidly as possible.

**Galveston, Tex.**—Western Union Telegraph Co. has presented an application to the city asking for an amendment to its franchise, allowing all remaining overhead wires to be placed underground. The company has the material on hand to begin the early part of February. The estimated cost of the improvements is about $67,000.

**McAllen, Tex.**—It is announced by R. F. McCord, general manager of the Rio Grande Public Service Corporation, that extensive improvements and enlargements of the electric light and water works systems and ice plant of that company here are to be made. Mr. McCord has been in New York conferring with the owners of these properties in regard to future plans for taking care of the increasing business and demands of the service. It is understood that considerable new machinery will be installed and the capacity of the plants more than doubled.

**Palacious, Tex.**—The city council at its regular meeting voted to buy the electric light plant, owned by the late Charles H. Trego. The lighting system will operated in connection with the city waterworks, and a 24-hour current is expected in the near future.

## WESTERN STATES.

**Petersburg, Colo.**—The power house of the National Alfalfa Products Co. was destroyed by fire recently.

**Clear Lake, Wash.**—Clear Lake Lumber Co. has almost finished the electrification of its sawmill. The Allis-Chalmers Manufacturing Co. installed the 1000-kw. steam turbine and made complete electrification of the mill.

**Hunters, Wash.**—The electric light plant was destroyed by fire.

**Los Angeles, Cal.**—Plans have been prepared by the Pacific Electric Railway Co. for the erection of a substation, 30 by 50 ft. in size, at Maple avenue and Seventh street.

**Los Angeles, Cal.**—In connection with the proposed construction of power plant No. 2 in the San Francisquito canyon, preliminary plans have been prepared for the installation of the steel pipe line and penstock, estimated to cost about $75,000. The Power Bureau of the Department of Public Service is in charge of the work.

**Richmond, Cal.**—The Richmond division of the Western States Gas & Electric Co. has secured a renewal of contracts with the Tilden Lumber Co. for five years, the California Cap Co. for three years, and with the Turner Dahnken theater for five years.

**San Pedro, Cal.** — Southwestern Shipbuilding Co. has had plans prepared for the construction of a new brick, steel and concrete transformer house at its works at East San Pedro.

**Stockton, Cal.** — National Paper Product Co. has completed its million dollar plant and started operations with 150 men. An additional 100 men will be employed as soon as possible. The plant has a capacity of 80 tons per day, a monthly pay roll of $40,000 and utilizes electric power from the Western States Gas & Electric Co. to the extent of 1400 hp.

## PROPOSALS

**Machines, Ovens, Etc.**—Bids will be received by the Navy Department, Bureau of Supplies and Accounts, for the following items: Electrically operated meat grinders (schedule 3607), 2 motor-driven die sinking machines, for delivery at the Boston. (Mass.) navy yard (schedule 3636), and electric bake ovens (schedule 3609) to be delivered at various navy yards.

**Electrical Material and Lighting Supplies.**—Bids will be received by the Navy Department, Bureau of Supplies and Accounts, for the following electrical material and lighting supplies: Direct-current ammeters, fuse blocks, fuse terminal blocks and clips, link fuses, testing magneto generators, back-connected knife switches (schedule 3579); 540 receptacle caps, combination plug and switch cutouts, shade holders, porcelain knobs, Edison base attachment plugs to be delivered at various navy yards, 1200 wall type receptacles for delivery at Charleston, S. C., 1000 Hubbell receptacles or bases for delivery at Philadelphia, Pa., brass key and keyless sockets, for delivery at Philadelphia, incandescent lamp sockets to be delivered at various navy yards, porcelain base entrance switches and push-button switches for delivery at Philadelphia, Pa. (schedule 3585); electric flatirons, portable non-watertight guards, electric heaters, desk type, electric soldering irons, telephone testing sets, for delivery at various navy yards, and 4000 illuminating set, rubber socket rings for delivery at Boston, Mass. (schedule 3580).

## INCORPORATIONS

**Callicoon, N. Y.**—Sullivan Electric Co. Capital, $10,000. To manufacture electrical specialties, etc. Incorporators: M. Hermann, F. M. Starck, and L. G. Gerhardt.

**Fulton, N. Y.**—Ontario Equipment Corporation. Capital, $10,000. To manufacture boilers, engines, etc. Incorporators: G. C. Hodgson, W. J. Hartnett, and G. M. Fanning, Fulton.

**Syracuse, N. Y.**—Garrett Electric Co. Capital, $10,000. To operate in a general electrical contracting capacity. Incorporators: F. P. Millis, F. G. Meigs, and B. H. Garrett.

# Personal

## G. E. Cullinan Promoted—M. H. Wagner Joins Electrical Engineering Staff of Bureau of Standards—Other Changes

SAMUEL H. ORDWAY, recently appointed a member of the Public Service Commission, New York, First District, to succeed Oscar Straus, has resigned.

JOSEPH T. RAABA, manager of the Akron branch of the Eureka Vacuum Cleaner Co., has been transferred to the management of the St. Louis branch of that company, with headquarters at 617 Locust street.

C. S. MACCALLA, formerly general manager of the Washington Power Co., with headquarters at Spokane, has severed his connection with the company to enter the employ of the General Electric Co. at Schenectady, N. Y.

FRANK J. MEYER has resigned as factory superintendent of the Southwest Manufacturing Co. to become electrical engineer with the Oklahoma Gas & Electric Co., with headquarters at Oklahoma City.

H. R. PALMER, in charge of the distribution of power for the Virginia Railways & Power Co., Richmond, Va., has been appointed to succeed Mr. C. M. Kaltwasser as head of the Harrisburg Light & Power Co., Harrisburg, Pa., resigned.

IRA J. FRANCIS, who for the past 18 months has been western manager of John A. Roebling's Sons Co. of California, was recently elected president of the company to succeed Squire V. Mooney, deceased.

GEORGE F SWAIN, professor of civil engineering at the Massachusetts Institute of Technology and Harvard University and a well known consulting engineer, is one of the American engineers chosen to go to France to discuss with French engineers problems of reconstruction. Mr. Swain will be abroad about six weeks.

D. J. YOUNG, of the San Diego Consolidated Gas & Electric Co., San Diego, Cal., has been appointed vice-president and general manager of the Tacoma Gas & Fuel Co., Tacoma, Wash., Olympia Gas Co., Olympia, Wash., and the Puget Sound Gas Co., Everett, Wash. Both of these appointments were effective Jan. 1.

JOHN MACFARLANE, until recently superintendent of the plants of the Harwood Electric Co., has been appointed chief engineer of the Scranton (Pa.) Electric Co. After leaving school Mr. Macfarlane was for two years associated with E. B. Cox testing stoker boilers and coal-handling machinery, later becoming a pump engineer with the Jeansville Iron Works. Shortly afterward he became operating and construction engineer for the Harwood Electric Co., during the construction of the Hauto plant, and upon its completion was appointed superintendent of all the company's plants.

ELMER DOVER, vice-president of H. M. Byllesby & Co., in charge of the Byllesby properties in the Pacific Northwest, has resigned, effective Feb. 1.

JOHN D. STOUT was recently appointed New York district manager of the Terry Steam Turbine Co. Mr. Stout has been assisting Mr. Herbert, formerly in complete charge of the district, but who will now devote his entire time to navy and marine requirements.

MILTON H. WAGNER, transmission engineer of the Dayton Power & Light Co., resigned on Nov. 1, 1918, to become connected with the United States Fuel Administration at Washington and on Dec. 16 he was transferred from the Fuel Administration to the electrical engineering staff of the Bureau of Standards, Department of Commerce. His

Milton H. Wagner.

work principally will be in connection with the National Electrical Safety Code. Mr. Wagner is a graduate of electrical engineering of the University of Cincinnati, Cincinnati, Ohio, and in 1909 became connected with the Dayton Power & Light Co. During the period of his employment with that company the latter built 150 miles of transmission line. Mr. Wagner was the first chairman of the Transmission and Distribution Committee of the Ohio Electric Light Association and continued in that capacity for an additional six years. He is also a member of the Technical Section of the National Electric Light Association and a member of the Subcommittee on Overhead Lines. He has been chairman of the Dayton Power & Light Co. Section of the National Electric Light Association and while serving in that capacity organized all of the various activities of the company under one organization which became known as the Dayton Power & Light Welfare Association of the N. E. L. A.

FRED W. FISCHER has resigned his position with the United States Nitrate Plant at Muscle Shoals, Ala., to become boiler-plant supervisor with the Du Pont Engineering Co.

C. M. BREWER, manager of the Richmond division of the Western States Gas & Electric Co., has been appointed vice-president and general manager of the Mountain States Power Co., operating in Montana, Idaho, Washington and Oregon.

S. LARUE TONE, formerly president of the Pittsburgh Railways Co. and formerly a member of the Public Service Commission, Pennsylvania, has been appointed receiver of the Pittsburgh Railways Co., Pittsburgh, Pa., to succeed J. D. Callery, resigned.

THOS. PITTS, formerly superintendent of the Hutchinson (Minn.) division of the Northwest Light & Power Co., has been appointed assistant manager of the Southwestern division of the Northern States Power Co. with headquarters at Montevideo, Minn.

C. W. KOINER, general manager and electrical engineer of Pasadena's Light & Power Works, has returned to his regular duties at Pasadena, Cal., after serving for a period in war work, having served with the engineering section, power department, of the United States Shipping Board, Emergency Fleet Corporation, looking after technical work and general power problems.

GEORGE E. CULLINAN, who has been manager of the St. Louis branch of the Western Electric Co., since 1909 and for the last several years district manager for the St. Louis district, was recently appointed western district manager with headquarters at Chicago, succeeding Frank A. Ketcham. Mr. Cullinan was born at Geneseo, N. Y., and is a graduate of the Geneseo State Normal School and Teachers' College. He entered the service of the Western Electric Co. in 1901 as a stock clerk in the New York branch. He later filled the positions of employment agent, shipping clerk and assistant traffic manager. In 1907 he was transferred to St. Louis as assistant branch manager and in 1909 was promoted to the position of manager.

### Obituary.

THOMAS G. DICKENSON, an electrical engineer, died Dec. 29, at his home, 464 Columbus avenue, New York, aged 32 years.

GEORGE W. BURT, aged thirty-nine, traffic manager of the Remy Electric Co., Anderson, Ind., died of double pneumonia, following influenza. Mr. Burt was a native of Muncie, Ind., and lived there until seven years ago.

JOHN E. WILLIAMS, formerly fuel administrator for Illinois, and widely known as an arbitrator in industrial disputes, died Jan. 2 at his home in Streator, Ill., after an illness of several months.

# Now that the War Is Won—What?

*XIX.*

## *Trade Outlets Abroad*

There need be no exaggeration in our expectation regarding foreign trade expansion, as long as our future development is laid upon careful and systematic plans. In order to carry out this desired result, our manufacturers, exporters and bankers must act in full co-operation, and it may not be amiss in this regard to point out that it has come to our attention that several manufacturers consider the exporter a somewhat unnecessary go-between. Only in such cases where a manufacturer has, by experience and organization, built up direct channels of trade with foreign buyers, is the need of an exporting house unnecessary. However, the large majority of manufacturers should avail themselves of the service of well established exporters, instead of trying to eliminate them by doing a direct trade. Experience and well established connections, combined with good credit information, are the main essentials for successful development at this time; and in order to avoid disappointment, our manufacturers should endeavor to acquire such assets through the best possible medium.

THIS QUOTATION from a circular issued by the National Park Bank of New York City, gives one of the most important facts now before American manufacturers. Think it over! Act!

*C. A. Tupper, President* . CHICAGO
INTERNATIONAL TRADE PRESS, Inc.

# Financial News

## War Finance Corporation Loans.

During six months' operation by the War Finance Corporation, since its creation by Congress, $71,387,000 was loaned by the corporation to public utilities and war industries for the improvement of the American war machine. A statement issued Dec. 3 on summing up its activities, says $40,828,000 of this amount was advanced to public utilities, $26,899,000 to other war industries and $3,628,000 to farmers and stock raisers.

## Allis-Chalmers Bookings Large.

Ending of the war has not had any serious adverse effect upon the Allis-Chalmers Manufacturing Co. so far as cancellation of orders is concerned, according to an analysis by a prominent investment concern. On Sept. 30 last Allis-Chalmers had on its books $32,382,333 of unfilled business, a total of between 10 and 11 months' production, based on the average of recent months.

This amount of unfilled orders did not include the shell order about which considerable comment has been made. This shell work was so partial in its nature and had been so recently undertaken that it was never absorbed into the books as an unfilled order. This work has naturally been cancelled. In addition the Allis-Chalmers company has received orders from government sources to hold up or suspend work on certain engine and pump equipment, and in one or two cases parts of orders have been cancelled.

In all this suspension or cancellation affects slightly less than $4,000,000 of business. There is, of course, a fair probability that orders to go ahead will be given in the case of certain suspended work. But even if all of this $4,000,000 be considered as permanently lost from the total of unfilled orders, Allis-Chalmers will still have by the end of December considerable unfinished business, sufficient to insure operations at capacity for nine months.

## Semi-Annual Report of General Electric Co.

According to a statement to the New York Stock Exchange, earnings of the General Electric Co. in the first six months of 1918 showed a surplus after charges of $23,332,000, and after deducting the $11,000,000 for excess profits, taxes and additional income taxes, the balance available for the outstanding stock was equivalent to approximately $10.85 per share. This rate, if maintained the full twelve months, would mean share profits of about $22 as compared with $26.50 in 1917, and $18.31 in 1916.

While the showing for the half year was more than up to expectations it does not fully tell the story. In all of 1917 General Electric Co. set aside only $5,500,000 for government taxes, which is just half of what directors set aside out of the six months' statement. Allowing the same amount for the half year as for 1917, share profits would be much higher for the capital stock.

Up to June 30 General Electric Co. billed sales of more than $98,000,000, which would indicate for the full year $196,000,000, the same as in 1917. As last year showed an increase of $62,000,000 over that of 1916, this huge total is fully up to expectations.

While the end of hostilities will naturally mean the cancellation of some war orders, it is not expected to cause much apprehension in view of the fact that domestic business has been utterly neglected for some time, and which will be resumed as soon as business is more settled. On this account it cannot be expected that total sales will run up to the record breaking total of a year ago.

One of the particularly pleasing features of the six months' report was the substantial gain in cash from the close of 1917. As of June 30 last General Electric Co. showed cash holdings of $24,844,000 as compared with $21,190,000 six months ago. Inventories expanded from approximately $71,000,000 to more than $90,000,000 in the same period.

## Pacific Gas & Electric Bonds Offered.

A Chicago syndicate composed of the National City Co., the Harris Trust & Savings Bank and Halsey, Stuart & Co. is offering $3,500,000 Pacific Gas & Electric Co. general and refunding 5% bonds at 87½, at which price the yield is 6%. The bonds mature in 1942.

## Western Light & Power Taken Over by New York Company.

The Cities Service Co. of New York has purchased the control of the Western Light & Power Co. of northern Colorado. The power plant is located near Lafayette, in the northern part of the state, and furnishes light and power to more than a dozen cities in that section. Improvements to cost over $1,000,000 are contemplated by the new owners. The Western Light & Power Co. has $2,000,000 common stock and $1,500,000 preferred, and has outstanding $2,100,000 first mortgage sinking fund 5s.

## Public Utility Deficits.

To supply cheap lights and power the city of Seattle has a deficit in its electric lighting department of $875,000. Money is to be transferred from the general funds to the depleted light account and as usual public ownership falls back on the taxpayer. The shortage is to be made up temporarily by using funds from sale of Skagit River power bonds, sold to build another city plant. In addition to this, Seattle politicians will again ask home rule powers to take their utilities out of the control of the Public Service Commission. This means that utilities will be thrown back into city politics, out of which they have been taken for the past six or eight years.

## Dividends.

The board of directors of the Northern States Power Co. has declared a quarterly dividend of 1¾% on the preferred stock of the company, payable Jan. 20, to stockholders of record at the close of business Dec. 31.

The Western States Gas & Electric Co. of Delaware has declared the quarterly dividend of 1¾% on the preferred stock of the company, payable Jan. 15, to stockholders of record Dec. 3.

The board of directors of the Ottumwa Railway, Light & Power Co. has declared a quarterly dividend of 1¾% on the preferred stock, payable Jan. 15 to stockholders of record Dec. 31.

West Penn Power Co. has declared a quarterly dividend of 1¾% on preferred stock, payable Feb. 1 to stock of record Jan., 21.

Milwaukee Electric Railway Co. has declared a quarterly dividend of $1.50 on preferred stock, payable Jan. 31 to stock of record Jan. 20.

Automatic Electric Co. has declared a quarterly dividend of 1%, payable Jan. 15 to stockholders of record Jan. 15.

Public Service Co. of Northern Illinois has declared a quarterly dividend of $1.50 a share on preferred stock and $1.75 a share on common stock, payable Feb. 1 to stockholders of record Jan. 15.

United Gas & Electric Co. has declared the usual semi-annual dividend of 2½% on preferred stock, payable Jan. 15 to stock of record Dec. 31.

WEEKLY COMPARISONS OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeller & Co., Rookery Bldg., Chicago.

| | Div. rate. Per cent. | Bid Dec. 31. | Bid Jan. 7. |
|---|---|---|---|
| Public Utilities— | | | |
| Adirondack Electric Power of Glens Falls, common | 6 | 14 | 14 |
| Adirondack Electric Power of Glens Falls, preferred | 6 | 67 | 68 |
| American Gas & Electric of New York, common | 10+extra | 98 | 98 |
| American Gas & Electric of New York, preferred | 6 | 43 | 43 |
| American Light & Traction of New York, common | .. | 242 | 243 |
| American Light & Traction of New York, preferred | 6 | 99 | 99 |
| American Power & Light of New York, common | 4 | 55 | 52 |
| American Power & Light of New York, preferred | 6 | 74 | 74 |
| American Public Utilities of Grand Rapids, common | .. | .. | .. |
| American Public Utilities of Grand Rapids, preferred | 7 | 35 | 35 |
| American Telephone & Telegraph of New York | .. | 98 | 101 |
| American Water Works & Elec. of New York, common | .. | 6½ | 6¼ |
| American Water Works & Elec. of New York, particip | 7 | 12 | 13 |
| American Water Works & Elec. of New York, first preferred | .. | 68 | 69 |
| Appalachian Power, common | .. | 2 | 2 |
| Appalachian Power, preferred | 7 | 10 | 12 |
| Cities Service of New York, common | +extra | 293 | 295 |
| Cities Service of New York, preferred | 6 | 80 | 80 |
| Commonwealth Edison of Chicago | 8 | .. | 115 |
| Comm. Power, Railway & Light of Jackson, common | .. | 22 | 22 |
| Comm. Power, Railway & Light of Jackson, preferred | 6 | 44 | 42 |
| Federal Light & Traction of New York, common | .. | 8½ | 8 |
| Federal Light & Traction of New York, preferred | .. | .. | 40 |
| Illinois Northern Utilities of Dixon | 6 | .. | .. |
| Middle West Utilities of Chicago, common | 2+extra | 24 | 24 |
| Middle West Utilities of Chicago, preferred | 6 | 54 | 52 |
| Northern States Power of Chicago, common | .. | 60 | 58 |
| Northern States Power of Chicago, preferred | ex.div.7 | 88½ | 87 |
| Pacific Gas & Electric of San Francisco, common | .. | 43 | 47 |
| Pacific Gas & Electric of San Francisco, preferred | 6 | 86 | 85 |
| Public Service of Northern Illinois, Chicago, common | 7 | 90 | 90 |
| Public Service of Northern Illinois, Chicago, preferred | 6 | 90 | 91 |
| Republic Railway & Light of Youngstown, common | 4 | 17½ | 16 |
| Republic Railway & Light of Youngstown, preferred | 6 | 57 | 52 |
| Standard Gas & Electric of Chicago, common | .. | 12 | 12 |
| Standard Gas & Electric of Chicago, preferred | 6 | 32 | 32 |
| Tennessee Railway, Light & Power of Chattanooga, common | .. | 2½ | 2 |
| Tennessee Railway, Light & Power of Chattanooga, preferred | 6 | 14 | 13 |
| United Light & Railways of Grand Rapids, common | 4 | 38 | 38 |
| United Light & Railways of Grand Rapids, preferred | 6 | 70 | 70 |
| Western Power of San Francisco, common | .. | 14 | 15 |
| Western Power of San Francisco, preferred | 6 | 59 | 63 |
| Western Union Telegraph of New York | extra | 86 | 87 |
| Industrials— | | | |
| Electric Storage of Philadelphia, common | 4 | 52¾ | 53¼ |
| General Electric of Schenectady | 8 | 143¾ | 151 |
| Westinghouse Electric & Mfg. of Pittsburgh, common | 7 | 42½ | 41 |
| Westinghouse Electric & Mfg. of Pittsburgh, preferred | 7 | 55 | 55 |